Institute for Water Resources
US Army Corps of Engineers

New Decision Support Tools to Assist in Corps Ecosystem Restoration Projects

L. Leigh Skaggs, IWR

Planning Community of Practice Conference

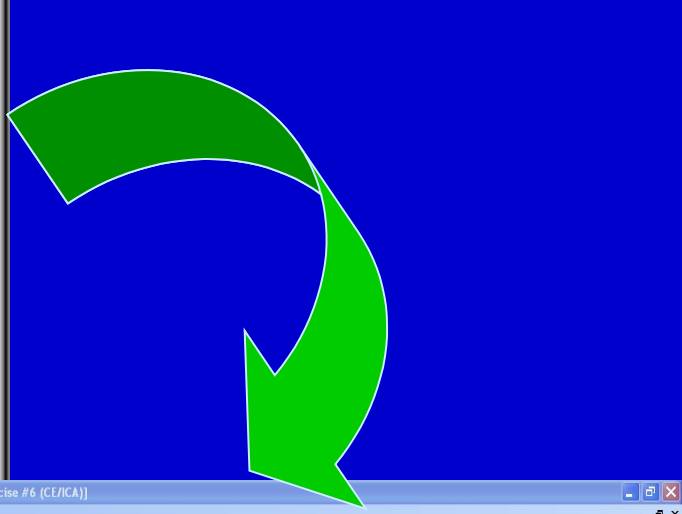
May 2008

Topics

- ***IWR Planning Suite improvements***
  - **Assists plan formulation**
  - **Performs Cost Effectiveness/ Incremental Cost Analyses (CE/ICA)**
  - **Annualizes ecosystem outputs & costs**
  - **Can assist in multi-criteria decision analysis (MCDA)**

IWR Planning Suite Background

- Evolutionary outgrowth of previous efforts to automate CE/ICA
- Tables & graphs as record of analyses
- Allows more complicated analyses
- Predecessors:
  - EcoEasy: MS-DOS based, USACE Evaluation of Environmental Investments Research Program, 1995
  - IWR-Plan Versions 1 to 3.33, MS-Access VBA-based application with C++ kernel, 1999-2002
- Current development environment: MS Visual Studio 2005, written in C-sharp



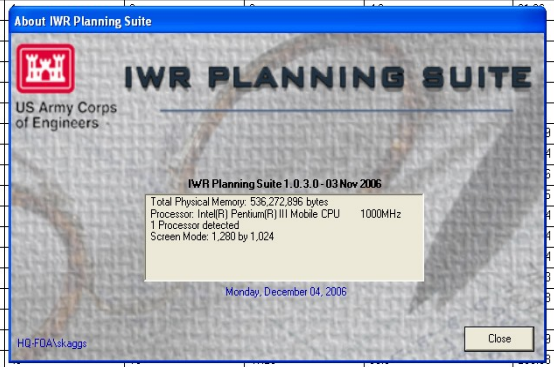
IWR Planning Suite Planning Study "BusseyLakeNov06" - [CEICA Synergy Exercise #6 (CE/ICA)]

File Edit View Window Analyze Results Decision Making Generator Help

CEICA Synergy Exercise #6 (CE/ICA)

Name	Totalcost	FishHU's	BirdHU's	Fauna	FishHU's High	Totalcost Low	Cost Effective
No Action Plan	0	0	0	0	0	0	Best Buy
D1H0A0S0K0I0	101.6	24	5	19.25	28.8	91.44	No
D2H0A0S0K0I0	122.7	28	7	22.75	33.6	110.43	No
D3H0A0S0K0I0	176.2	33	9	27	39.6	158.58	No
D4H0A0S0K0I0	192	41	12	33.75	49.2	172.8	No
D5H0A0S0K0I0	196.1	42	15	35.25	50.4	176.49	No
D6H0A0S0K0I0	205.2	44	18	37.5	52.8	184.68	No
D7H0A0S0K0I0	227.2	48	25	42.25	57.6	204.48	No
D0H1A0S0K0I0	23.4						No
D0H2A0S0K0I0	26						No
D0H3A0S0K0I0	28.6						No
D0H4A0S0K0I0	30						No
D0H5A0S0K0I0	30.8						No
D1H1A0S0K0I0	125						No
D2H1A0S0K0I0	146.1						No
D3H1A0S0K0I0	199.6						No
D4H1A0S0K0I0	215.4						No
D5H1A0S0K0I0	219.5						No
D6H1A0S0K0I0	228.6						No
D7H1A0S0K0I0	250.6						No
D1H2A0S0K0I0	127.6						No
D2H2A0S0K0I0	148.7						No
D3H2A0S0K0I0	202.2						No
D4H2A0S0K0I0	218						No
D5H2A0S0K0I0	222.1						No
D6H2A0S0K0I0	231.2						No
D7H2A0S0K0I0	253.2	53	25	46	63.6	227.88	No
D1H3A0S0K0I0	130.2	35	5	27.5	42	117.18	No
D2H3A0S0K0I0	151.3	39	7	31	46.8	136.17	No
D3H3A0S0K0I0	204.8	44	9	35.25	52.8	184.32	No
D4H3A0S0K0I0	220.6	52	12	42	62.4	198.54	No
D5H3A0S0K0I0	224.7	53	15	43.5	63.6	202.23	No
D6H3A0S0K0I0	233.8	55	18	45.75	66	210.42	No
D7H3A0S0K0I0	255.8	59	25	50.5	70.8	230.22	No
D1H4A0S0K0I0	131.6	38	5	29.75	45.6	118.44	No
D2H4A0S0K0I0	152.7	42	7	33.25	50.4	137.43	No
D3H4A0S0K0I0	206.2	47	9	37.5	56.4	185.58	No
D4H4A0S0K0I0	222	55	12	44.25	66	199.8	No

446 Plans | About IWR Planning Suite... | 12/4/2006

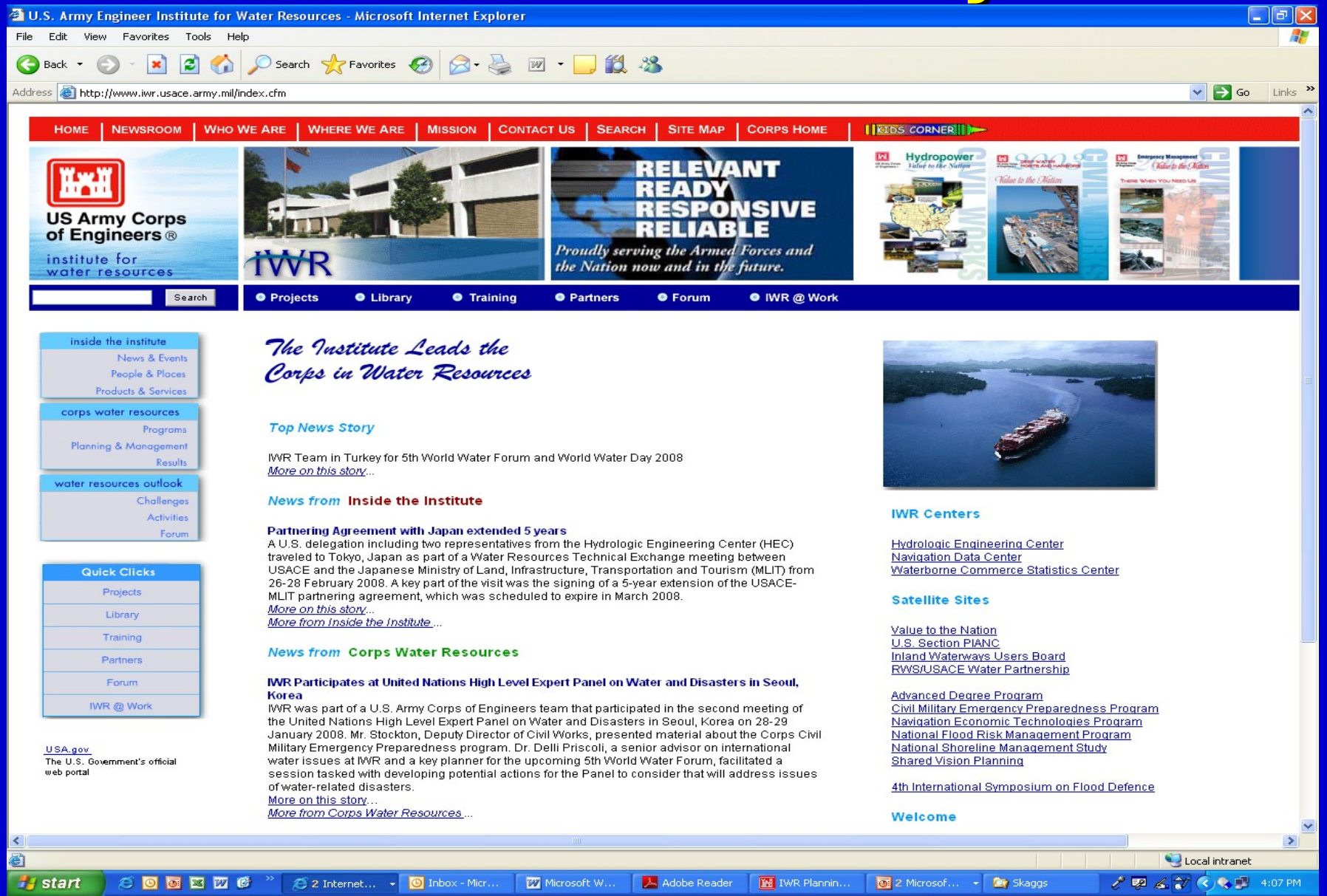

About IWR Planning Suite
IWR PLANNING SUITE
US Army Corps of Engineers
IWR Planning Suite 1.0.3.0 - 03 Nov 2006
Total Physical Memory: 536,272,896 bytes
Processor: Intel(R) Pentium(R) III Mobile CPU 1000MHz
1 Processor detected
Screen Mode: 1,280 by 1,024
Monday, December 04, 2006
HQ-FOA\skaggs
Close

IWR Plan - Microsoft Internet Explorer
IWR PLAN
US Army Corps of Engineers
COST EFFECTIVENESS
INCREMENTAL COST ANALYSIS
General Info. | Classic IWR-PLAN | New Version | News Board | Dev. Team | Site Map
WELCOME...
to the IWR-PLAN Decision Support Software Site. The US Army Corps of Engineers Institute for Water Resources provides this site to supply news and information related to IWR-PLAN and to provide access to the IWR-PLAN download site.
Developed in partnership with the Social Sciences Institute of the Natural Resources Conservation Service, IWR-PLAN was initially designed to assist with the formulation and comparison of alternative plans for ecosystem restoration and watershed planning studies. However, the program can be applied to planning studies addressing a wide variety of problems.
Briefly, IWR-PLAN assists with plan formulation by combining user-defined solutions to planning problems and calculating the effects of each combination, or "plan." The program can assist with plan comparison by conducting cost effectiveness and incremental cost analyses, identifying the plans which are best financial investments and displaying the effects of each on a range of decision variables. For a more detailed explanation of IWR-PLAN's capabilities, click on the General Info button of the navigation chart above.
Download and installation instructions are provided by clicking on the Software Info button of the navigation bar above. IWR-PLAN program files require about 13 megabytes of hard disk storage space and often take about 20 to 30 minutes to download, depending on Internet traffic volumes and modem speeds. Click on the Software Info button above for more detailed information on hardware and software system requirements.
IWR-PLAN is free to the public. We encourage its use and welcome user feedback. Future software enhancements and capabilities are scheduled. As these modifications are completed and tested, they will be incorporated into new versions of the software and made available from the download site. New versions will be announced on the News Board. Check the News Board regularly for information about future IWR-PLAN updates.
For more information about the US Army Corps of Engineers: USACE Home or our Institute for Water Resources: IWR Home
Latest News concerning IWR-PLAN decision support software
New Version Available!
Version 3.3 Available!
Workaround for MS Office 2000 users
Home | General Info. | Software Info. | New Software Info. | News Board | Dev. Team

IWR-Planning Suite

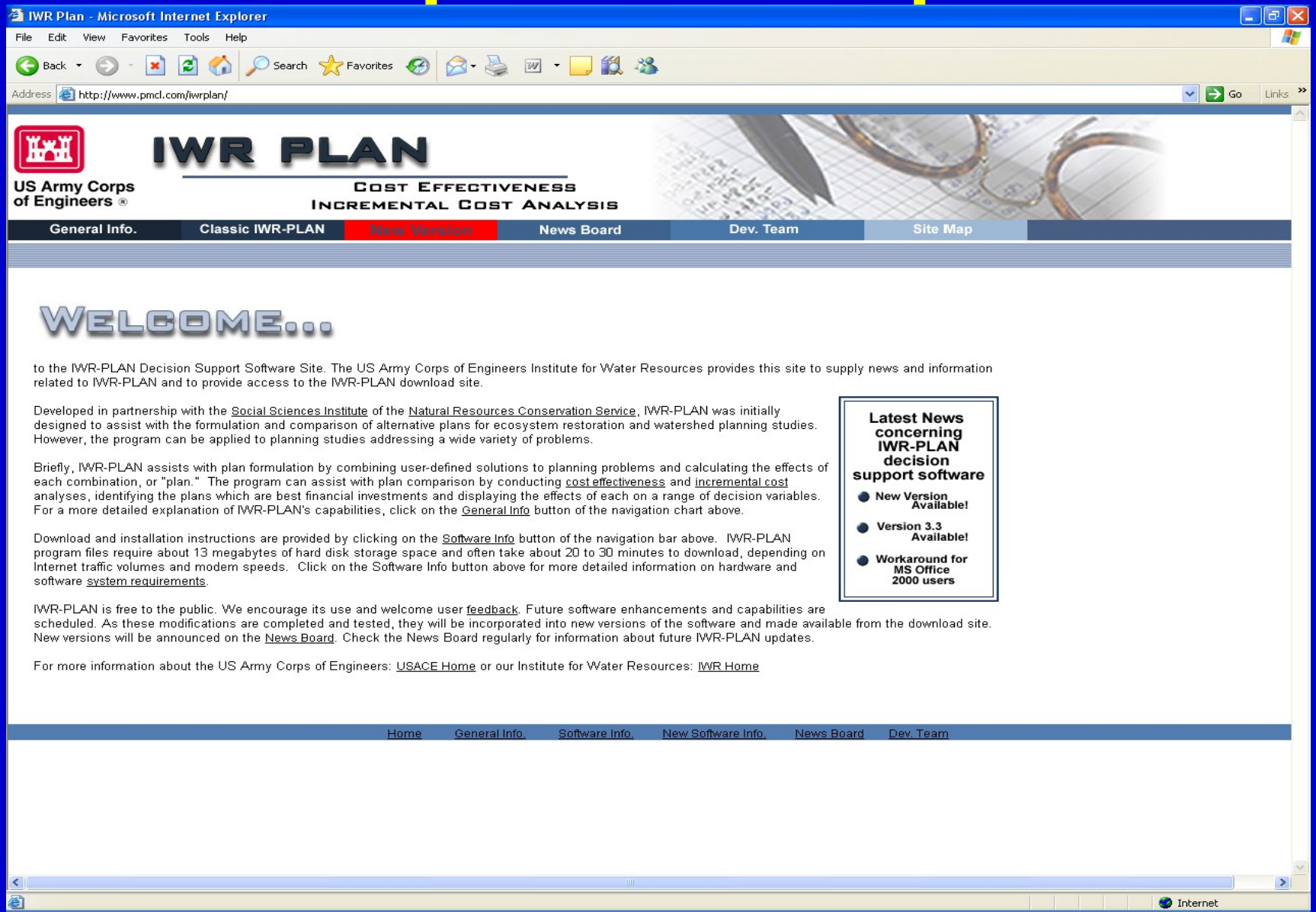
- **Available on web**
- **Website: *www.pmcl.com/iwrplan***
  - **Instructions**
  - **Student tutorial**
  - **User's Guide**
- **For on-line help, click on "?"**

Visit IWR's Homepage
www.iwr.usace.army.mil


U.S. Army Engineer Institute for Water Resources - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www.iwr.usace.army.mil/index.cfm
Go Links
HOME | NEWSROOM | WHO WE ARE | WHERE WE ARE | MISSION | CONTACT US | SEARCH | SITE MAP | CORPS HOME | KIDS CORNER
US Army Corps of Engineers®
institute for water resources
IWR
RELEVANT
READY
RESPONSIVE
RELIABLE
Proudly serving the Armed Forces and the Nation now and in the future.
Hydropower
Value to the Nation
Search
Projects Library Training Partners Forum IWR @ Work
inside the institute
News & Events
People & Places
Products & Services
corps water resources
Programs
Planning & Management
Results
water resources outlook
Challenges
Activities
Forum
Quick Clicks
Projects
Library
Training
Partners
Forum
IWR @ Work
USA.gov
The U.S. Government's official web portal
The Institute Leads the Corps in Water Resources
Top News Story
IWR Team in Turkey for 5th World Water Forum and World Water Day 2008
More on this story...
News from Inside the Institute
Partnering Agreement with Japan extended 5 years
A U.S. delegation including two representatives from the Hydrologic Engineering Center (HEC) traveled to Tokyo, Japan as part of a Water Resources Technical Exchange meeting between USACE and the Japanese Ministry of Land, Infrastructure, Transportation and Tourism (MLIT) from 26-28 February 2008. A key part of the visit was the signing of a 5-year extension of the USACE-MLIT partnering agreement, which was scheduled to expire in March 2008.
More on this story...
More from Inside the Institute...
News from Corps Water Resources
IWR Participates at United Nations High Level Expert Panel on Water and Disasters in Seoul, Korea
IWR was part of a U.S. Army Corps of Engineers team that participated in the second meeting of the United Nations High Level Expert Panel on Water and Disasters in Seoul, Korea on 28-29 January 2008. Mr. Stockton, Deputy Director of Civil Works, presented material about the Corps Civil Military Emergency Preparedness program. Dr. Delli Priscoli, a senior advisor on international water issues at IWR and a key planner for the upcoming 5th World Water Forum, facilitated a session tasked with developing potential actions for the Panel to consider that will address issues of water-related disasters.
More on this story...
More from Corps Water Resources...
IWR Centers
Hydrologic Engineering Center
Navigation Data Center
Waterborne Commerce Statistics Center
Satellite Sites
Value to the Nation
U.S. Section PIANC
Inland Waterways Users Board
RWS/USACE Water Partnership
Advanced Degree Program
Civil Military Emergency Preparedness Program
Navigation Economic Technologies Program
National Flood Risk Management Program
National Shoreline Management Study
Shared Vision Planning
4th International Symposium on Flood Defence
Welcome
Local intranet
start
2 Internet...
Inbox - Micr...
Microsoft W...
Adobe Reader
IWR Plannin...
2 Microsof...
Skaggs
4:07 PM

Visit the *IWR-PLAN* Homepage

www.pmcl/com/iwrplan


IWR Plan - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www.pmcl.com/iwrplan/
Go Links
US Army Corps of Engineers
IWR PLAN
COST EFFECTIVENESS
INCREMENTAL COST ANALYSIS
General Info.
Classic IWR-PLAN
New Version
News Board
Dev. Team
Site Map
WELCOME...
to the IWR-PLAN Decision Support Software Site. The US Army Corps of Engineers Institute for Water Resources provides this site to supply news and information related to IWR-PLAN and to provide access to the IWR-PLAN download site.
Developed in partnership with the Social Sciences Institute of the Natural Resources Conservation Service, IWR-PLAN was initially designed to assist with the formulation and comparison of alternative plans for ecosystem restoration and watershed planning studies. However, the program can be applied to planning studies addressing a wide variety of problems.
Briefly, IWR-PLAN assists with plan formulation by combining user-defined solutions to planning problems and calculating the effects of each combination, or "plan." The program can assist with plan comparison by conducting cost effectiveness and incremental cost analyses, identifying the plans which are best financial investments and displaying the effects of each on a range of decision variables. For a more detailed explanation of IWR-PLAN's capabilities, click on the General Info button of the navigation chart above.
Download and installation instructions are provided by clicking on the Software Info button of the navigation bar above. IWR-PLAN program files require about 13 megabytes of hard disk storage space and often take about 20 to 30 minutes to download, depending on Internet traffic volumes and modem speeds. Click on the Software Info button above for more detailed information on hardware and software system requirements.
Latest News concerning IWR-PLAN decision support software
New Version Available!
Version 3.3 Available!
Workaround for MS Office 2000 users
IWR-PLAN is free to the public. We encourage its use and welcome user feedback. Future software enhancements and capabilities are scheduled. As these modifications are completed and tested, they will be incorporated into new versions of the software and made available from the download site. New versions will be announced on the News Board. Check the News Board regularly for information about future IWR-PLAN updates.
For more information about the US Army Corps of Engineers: USACE Home or our Institute for Water Resources: IWR Home
Home General Info. Software Info. New Software Info. News Board Dev. Team
Internet

IWR Planning Suite Basics

- **Assists in plan formulation**
  - **Builds “all plan combinations”**
  - **52 solutions, 20 scales each**
  - **Also, fully formulated alternatives**
  - **Dependency & combinability relationships**
- **No limit on number of variables, including:**
  - **Costs**
  - **1 or more outputs**
  - **Other “effects”**
  - **“Derived” outputs (formulaic combinations of other variables)**
- **Performs CE/ICA**
  - **CEA: Cost effective plans**
  - **ICA: Best buy plans**

Features

Analytical

- Multiple planning sets
- Constraints
- Sensitivity – variable & solution
- Automated Editing – non-additive effects
- Exclude solutions
- Multi-planning set comparisons
- “Plans of Interest”

Reporting

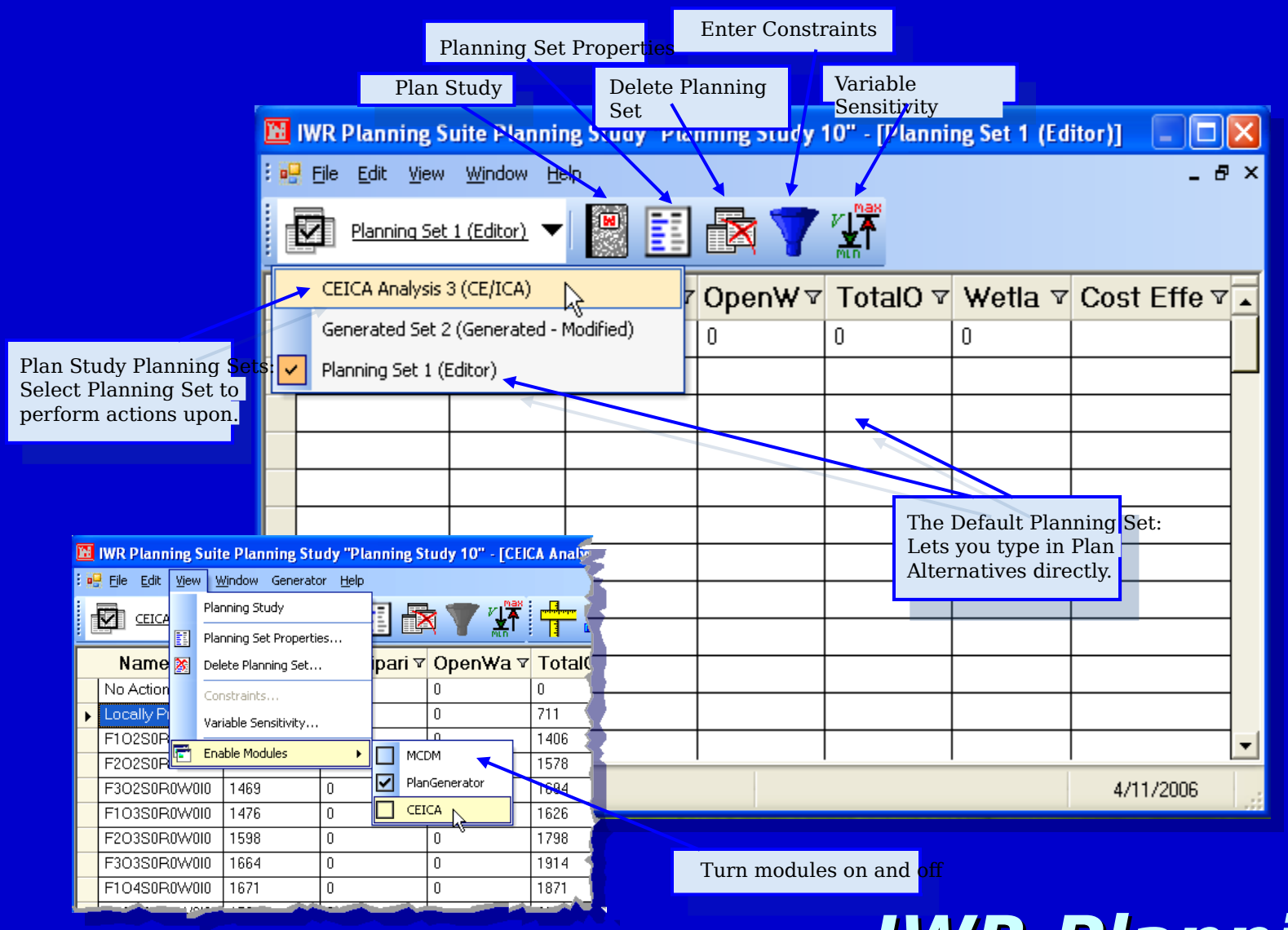
- Multiple display/ report options
- Import/ Export options

Features

Comprised of modules:

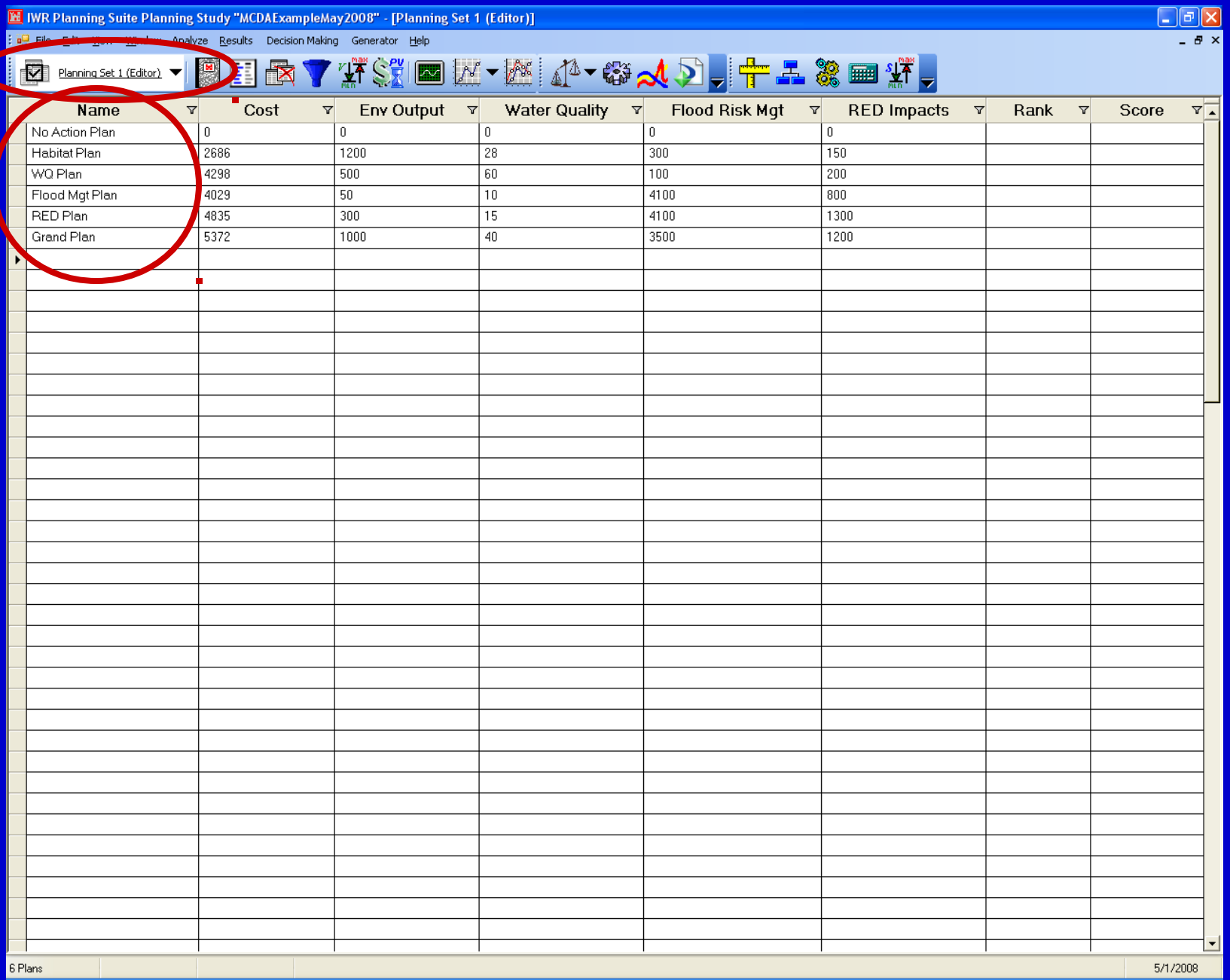
- **Plan Editor**
  - **also “framework” for other modules**
- **Plan Generator**
  - **builds combinations**
- **Plan Analysis**
  - **performs CE/ICA**
- **Annualizer**
  - **beta testing**
- **Multi-criteria Decision Analysis**
  - **beta testing**

Plan Editor Overview

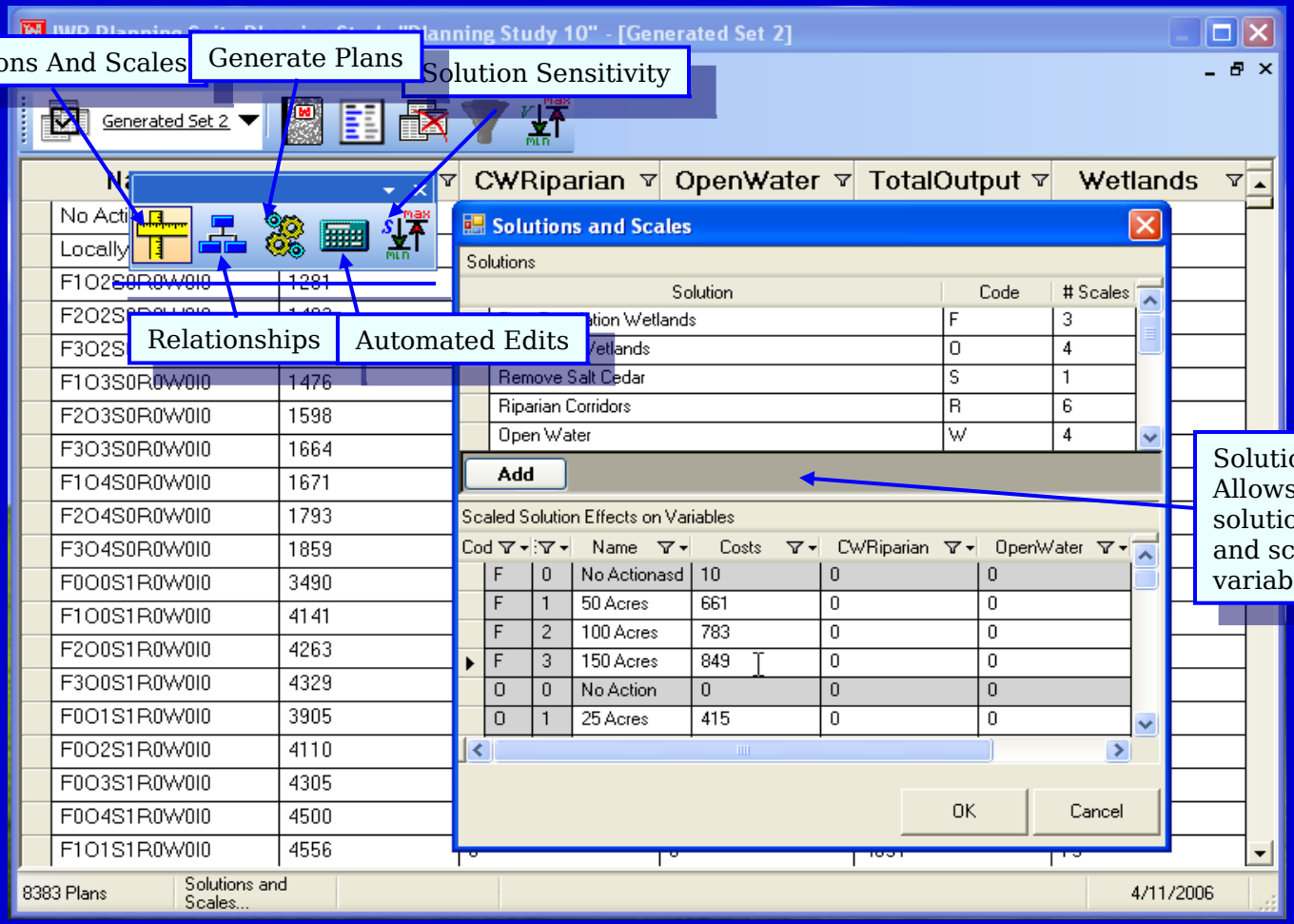


IWR Planning Suite

Editor Module


IWR Planning Suite Planning Study "MCDAExampleMay2008" - [Planning Set 1 (Editor)]
File Edit View Window Analyze Results Decision Making Generator Help
Planning Set 1 (Editor)
Name
Cost
Env Output
Water Quality
Flood Risk Mgt
RED Impacts
Rank
Score
No Action Plan 0 0 0 0 0
Habitat Plan 2686 1200 28 300 150
WQ Plan 4298 500 60 100 200
Flood Mgt Plan 4029 50 10 4100 800
RED Plan 4835 300 15 4100 1300
Grand Plan 5372 1000 40 3500 1200
6 Plans
5/1/2008

Plan Generator Module

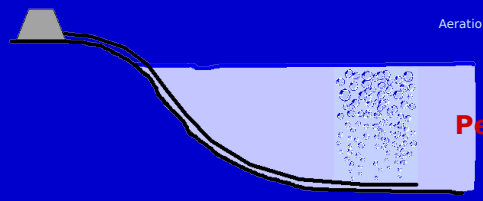


Solution Editor: Allows user to edit solution and scales and scaled effects on variables.

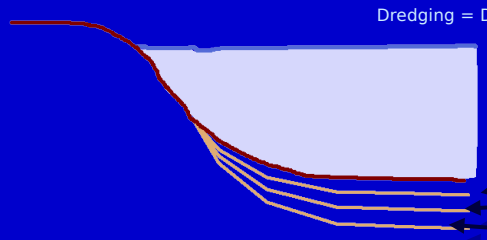
IWR Planning Suite

Plan Alternative Example

“Perform aeration, dredge 185,000 cubic yards of sediment, do no aquatic plant harvesting, and improve the substrate.”

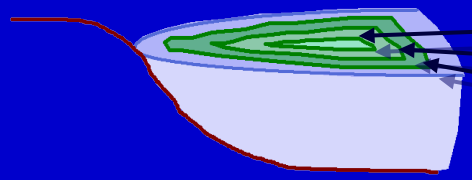


Perform Aeration = A1



(Cubic Yards)
140,000 = D1
185,000 = D2
220,000 = D3

Aquatic Plant Harvesting = H



No Action = H0
21 Acres = H1
42 Acres = H2
63 Acres = H3

Substrate Improvement = S

Improve Substrate = S1

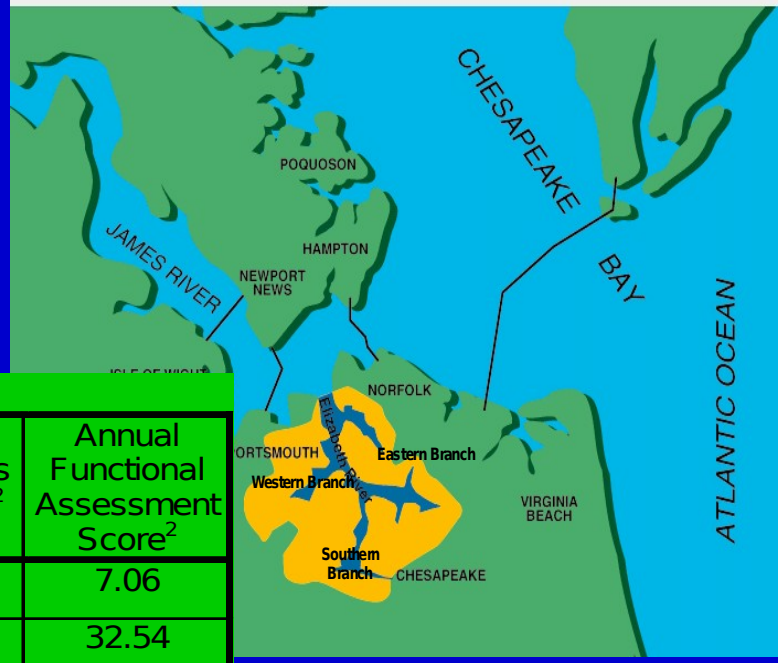
Plan alternative broken down:
- Perform Aeration is A1
- Dredge 185,000 Cubic Yards is D2
- Do not harvest (No Action) is H0
- Improve Substrate is S1

A1	D2	H0	S1

No Action

No Aeration = A0
No Dredging = D0
No Harvesting = H0
No Substrate = S0

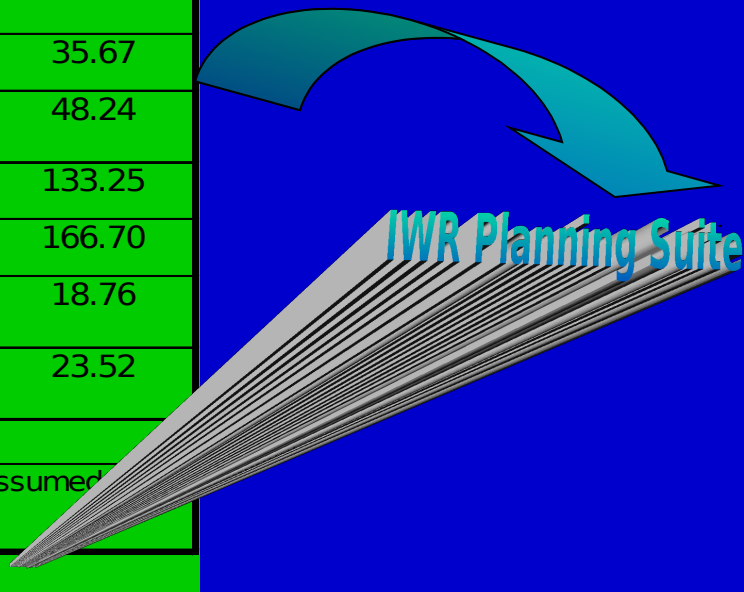
Elizabeth River Wetlands Case Study



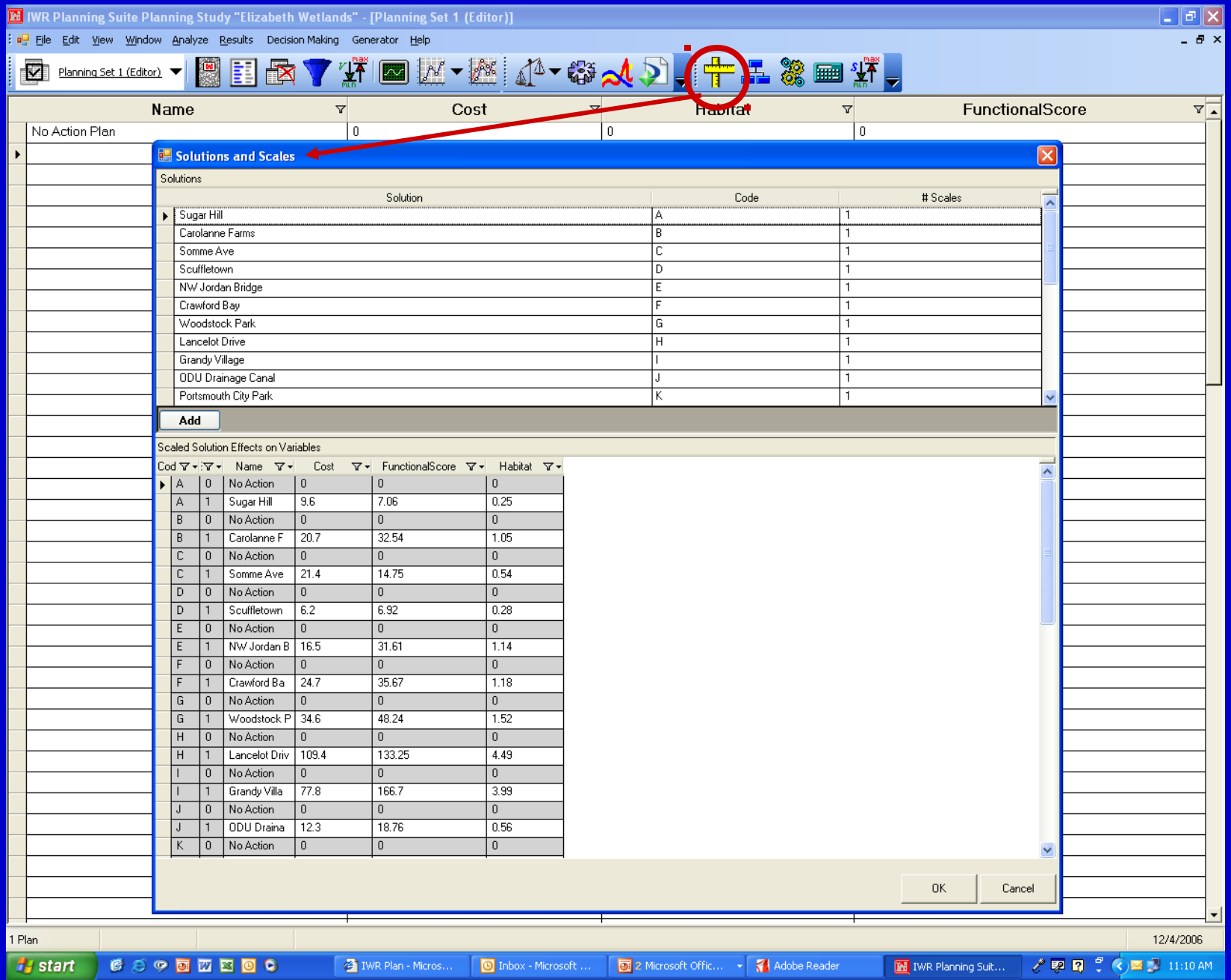
Location	Total Implementation Costs	Average Annual Costs[1]	Annual Habitat Units (from HEP)[2]	Annual Functional Assessment Score[2]
Sugar Hill, Portsmouth	$136,876	$9,600	0.25	7.06
Carolanne Farms, VA Beach	$297,431	$20,700	1.05	32.54
Somme Avenue, Norfolk	$308,610	$21,400	0.54	14.75
Scuffletown, Chesapeake	$87,781	$6,200	0.28	6.92
NW Jordan Bridge, Portsmouth	$237,564	$16,500	1.14	31.61
Crawford Bay, Portsmouth	$355,413	$24,700	1.18	35.67
Woodstock Park, VA Beach	$499,738	$34,600	1.52	48.24
Lancelot Drive, VA Beach	$1,583,079	$109,400	4.49	133.25
Grandy Village, Norfolk	$1,124,410	$77,800	3.99	166.70
ODU Drainage Canal, Norfolk	$175,795	$12,300	0.56	18.76
Portsmouth City Park, Portsmouth	$333,369	$23,200	0.67	23.52

[1] Average annual equivalent costs derived using an interest rate of 6-5/8%.

[2] Full realization of benefits is anticipated in year 3. Linear interpolation of benefits is assumed between years one and three.



Enter Cost & Environmental Output Data (Wetlands)


IWR Planning Suite Planning Study "Elizabeth Wetlands" - [Planning Set 1 (Editor)]
File Edit View Window Analyze Results Decision Making Generator Help
Planning Set 1 (Editor)
Name Cost Habitat FunctionalScore
No Action Plan 0 0 0
Solutions and Scales
Solutions
Solution Code # Scales
Sugar Hill A 1
Carolanne Farms B 1
Somme Ave C 1
Scuffletown D 1
NW Jordan Bridge E 1
Crawford Bay F 1
Woodstock Park G 1
Lancelot Drive H 1
Grandy Village I 1
ODU Drainage Canal J 1
Portsmouth City Park K 1
Add
Scaled Solution Effects on Variables
Cod Name Cost FunctionalScore Habitat
A 0 No Action 0 0 0
A 1 Sugar Hill 9.6 7.06 0.25
B 0 No Action 0 0 0
B 1 Carolanne F 20.7 32.54 1.05
C 0 No Action 0 0 0
C 1 Somme Ave 21.4 14.75 0.54
D 0 No Action 0 0 0
D 1 Scuffletown 6.2 6.92 0.28
E 0 No Action 0 0 0
E 1 NW Jordan B 16.5 31.61 1.14
F 0 No Action 0 0 0
F 1 Crawford Ba 24.7 35.67 1.18
G 0 No Action 0 0 0
G 1 Woodstock P 34.6 48.24 1.52
H 0 No Action 0 0 0
H 1 Lancelot Driv 109.4 133.25 4.49
I 0 No Action 0 0 0
I 1 Grandy Villa 77.8 166.7 3.99
J 0 No Action 0 0 0
J 1 ODU Draina 12.3 18.76 0.56
K 0 No Action 0 0 0
OK Cancel
1 Plan
12/4/2006
start
IWR Plan - Micros...
Inbox - Microsoft ...
2 Microsoft Offic...
Adobe Reader
IWR Planning Suit...
11:10 AM

(2,048)

IWR Planning Suite Planning Study "Eliz Wet May 2008" - [Generated Set 2 (Generated)]

File Edit View Window Analyze Results Decision Making Generator Help

Generated Set 2 (Generated)

Name	Cost	Habitat	Functional Scor
No Action Plan	0	0	0
A1B0C0D0E0F0G0H0I0J0K0	9.6	0.25	7.06
A0B1C0D0E0F0G0H0I0J0K0	20.7	1.05	32.54
A1B1C0D0E0F0G0H0I0J0K0	30.3	1.3	39.6
A0B0C1D0E0F0G0H0I0J0K0	21.4	0.54	14.75
A1B0C1D0E0F0G0H0I0J0K0	31	0.79	21.81
A0B1C1D0E0F0G0H0I0J0K0	42.1	1.59	47.29
A1B1C1D0E0F0G0H0I0J0K0	51.7	1.84	54.35
A0B0C0D1E0F0G0H0I0J0K0	6.2	0.28	6.92
A1B0C0D1E0F0G0H0I0J0K0	15.8	0.53	13.98
A0B1C0D1E0F0G0H0I0J0K0	26.9	1.33	39.46
A1B1C0D1E0F0G0H0I0J0K0	36.5	1.58	46.52
A0B0C1D1E0F0G0H0I0J0K0	27.6	0.82	21.67
A1B0C1D1E0F0G0H0I0J0K0	37.2	1.07	28.73
A0B1C1D1E0F0G0H0I0J0K0	48.3	1.87	54.21
A1B1C1D1E0F0G0H0I0J0K0	57.9	2.12	61.27
A0B0C0D0E1F0G0H0I0J0K0	16.5	1.14	31.61
A1B0C0D0E1F0G0H0I0J0K0	26.1	1.39	38.67
A0B1C0D0E1F0G0H0I0J0K0	37.2	2.19	64.15
A1B1C0D0E1F0G0H0I0J0K0	46.8	2.44	71.21
A0B0C1D0E1F0G0H0I0J0K0	37.9	1.68	46.36
A1B0C1D0E1F0G0H0I0J0K0	47.5	1.93	53.42
A0B1C1D0E1F0G0H0I0J0K0	58.6	2.73	78.9
A1B1C1D0E1F0G0H0I0J0K0	68.2	2.98	85.96
A0B0C0D1E1F0G0H0I0J0K0	22.7	1.42	38.53
A1B0C0D1E1F0G0H0I0J0K0	32.3	1.67	45.59
A0B1C0D1E1F0G0H0I0J0K0	43.4	2.47	71.07
A1B1C0D1E1F0G0H0I0J0K0	53	2.72	78.13
A0B0C1D1E1F0G0H0I0J0K0	44.1	1.96	53.28
A1B0C1D1E1F0G0H0I0J0K0	53.7	2.21	60.34
A0B1C1D1E1F0G0H0I0J0K0	64.8	3.01	85.82
A1B1C1D1E1F0G0H0I0J0K0	74.4	3.26	92.88
A0B0C0D0E0F1G0H0I0J0K0	24.7	1.18	35.67
A1B0C0D0E0F1G0H0I0J0K0	34.3	1.43	42.73
A0B1C0D0E0F1G0H0I0J0K0	45.4	2.23	68.21
A1B1C0D0E0F1G0H0I0J0K0	55	2.48	75.27
A0B0C1D0E0F1G0H0I0J0K0	46.1	1.72	50.42
A1B0C1D0E0F1G0H0I0J0K0	55.7	1.97	57.48

2048 Plans

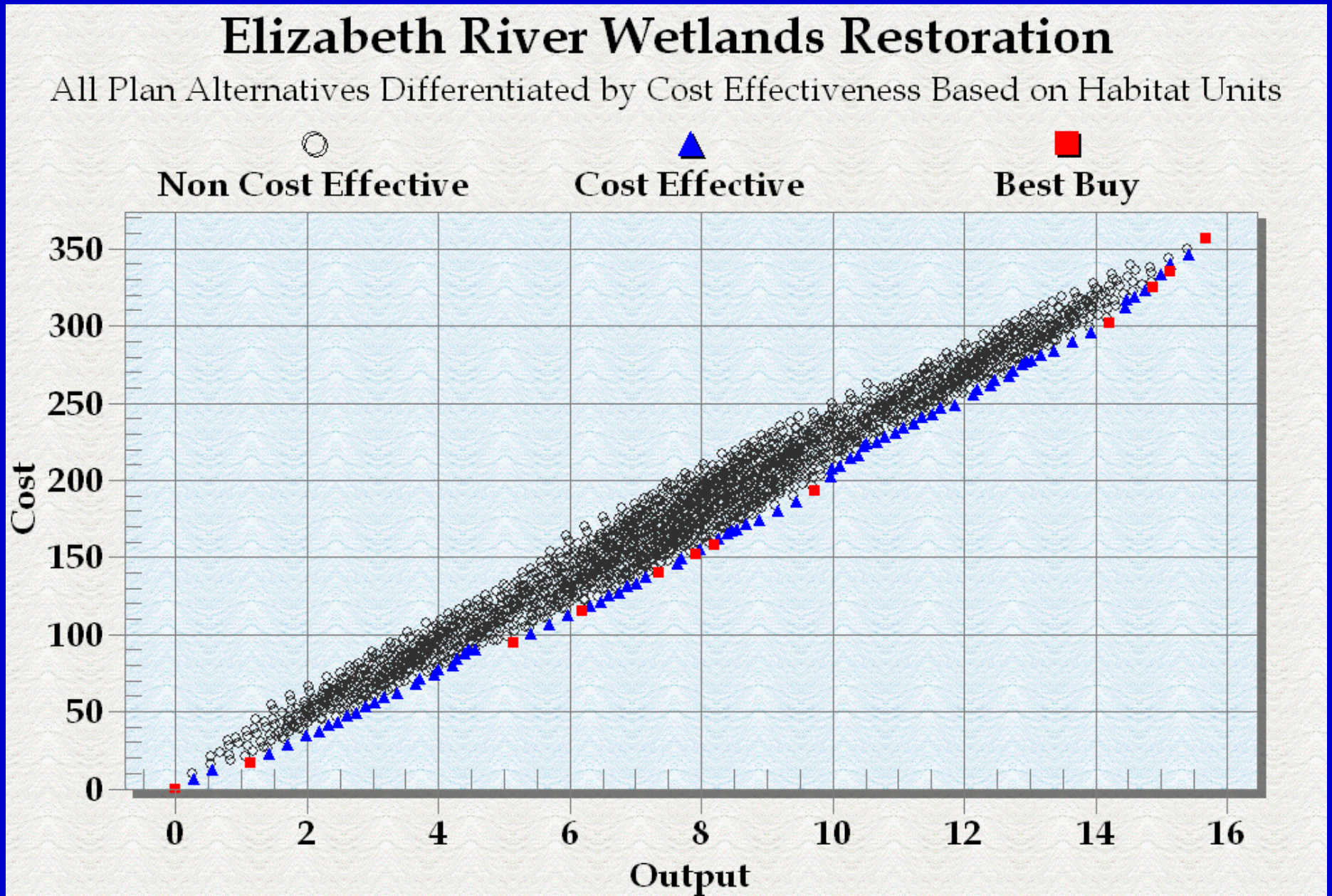
5/1/2008

start

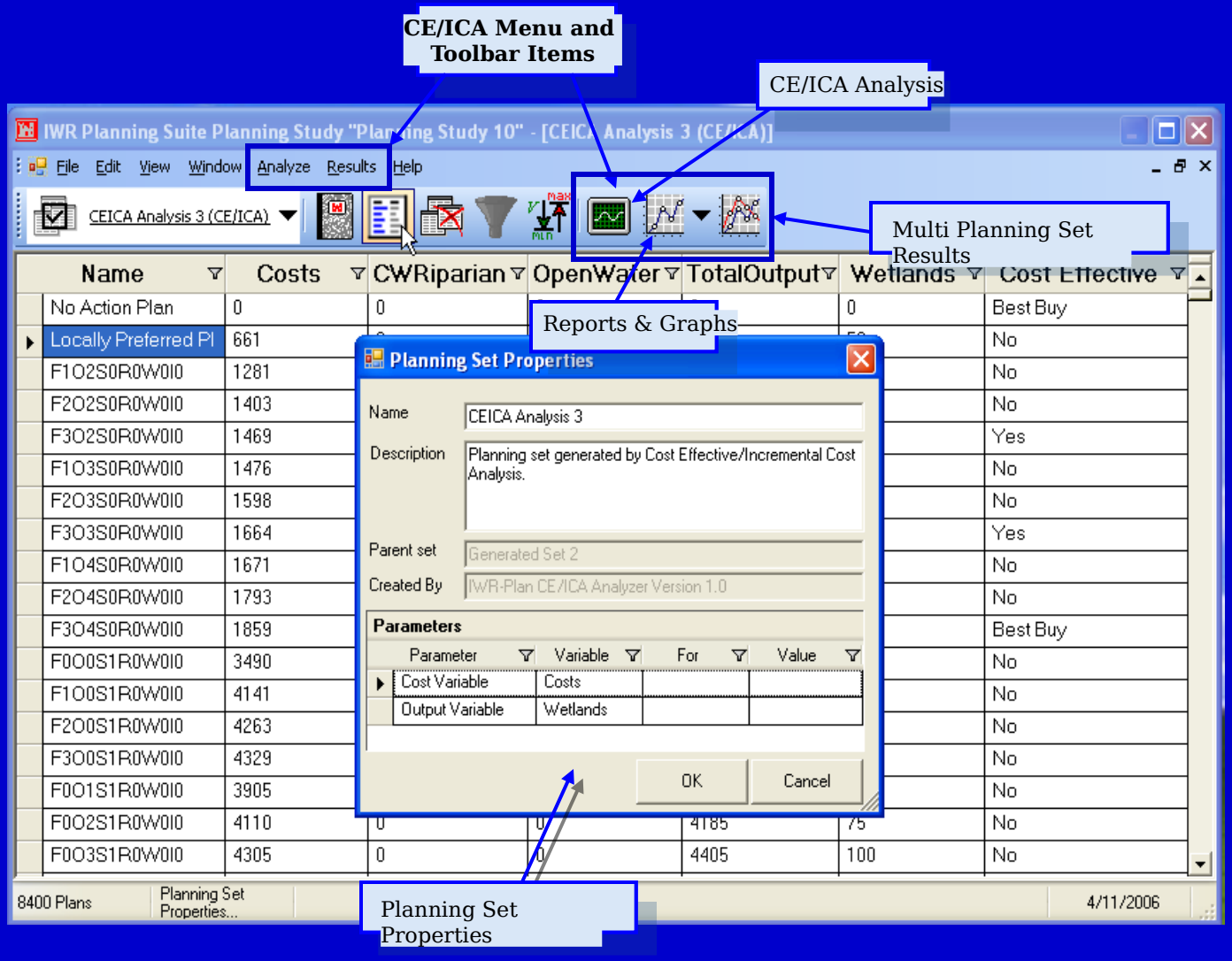
Sent Items - Microsof... IWRPlanSuite_for_PC... Microsoft Excel - Eliza... IWR Planning Suite Pl...

12:36 PM

(2,048)

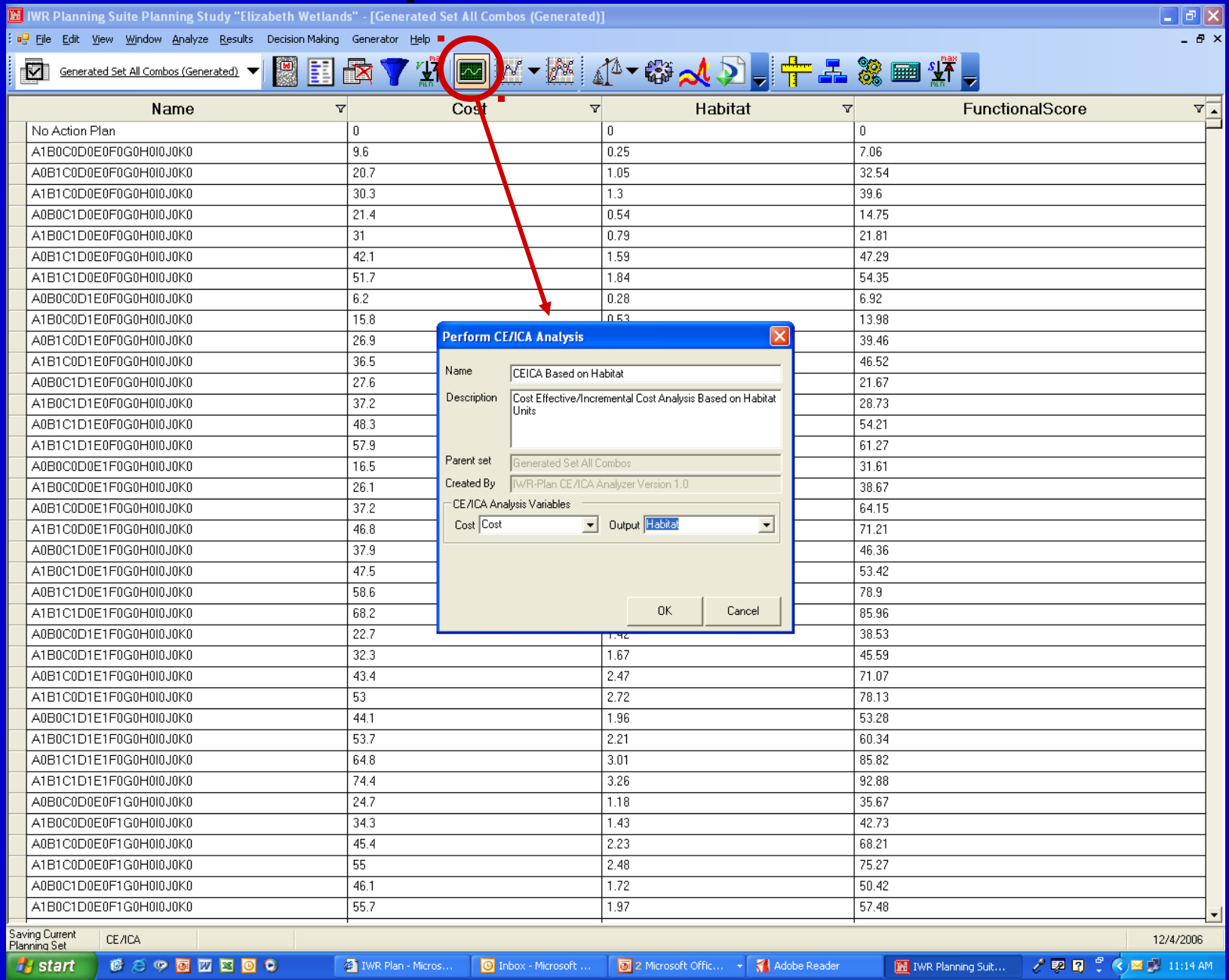

Elizabeth River Wetlands Restoration
All Plan Alternatives Differentiated by Cost Effectiveness Based on Habitat Units
Non Cost Effective
Cost Effective
Best Buy
Cost
350
300
250
200
150
100
50
0
0
2
4
6
8
10
12
14
16
Output

Analysis Module

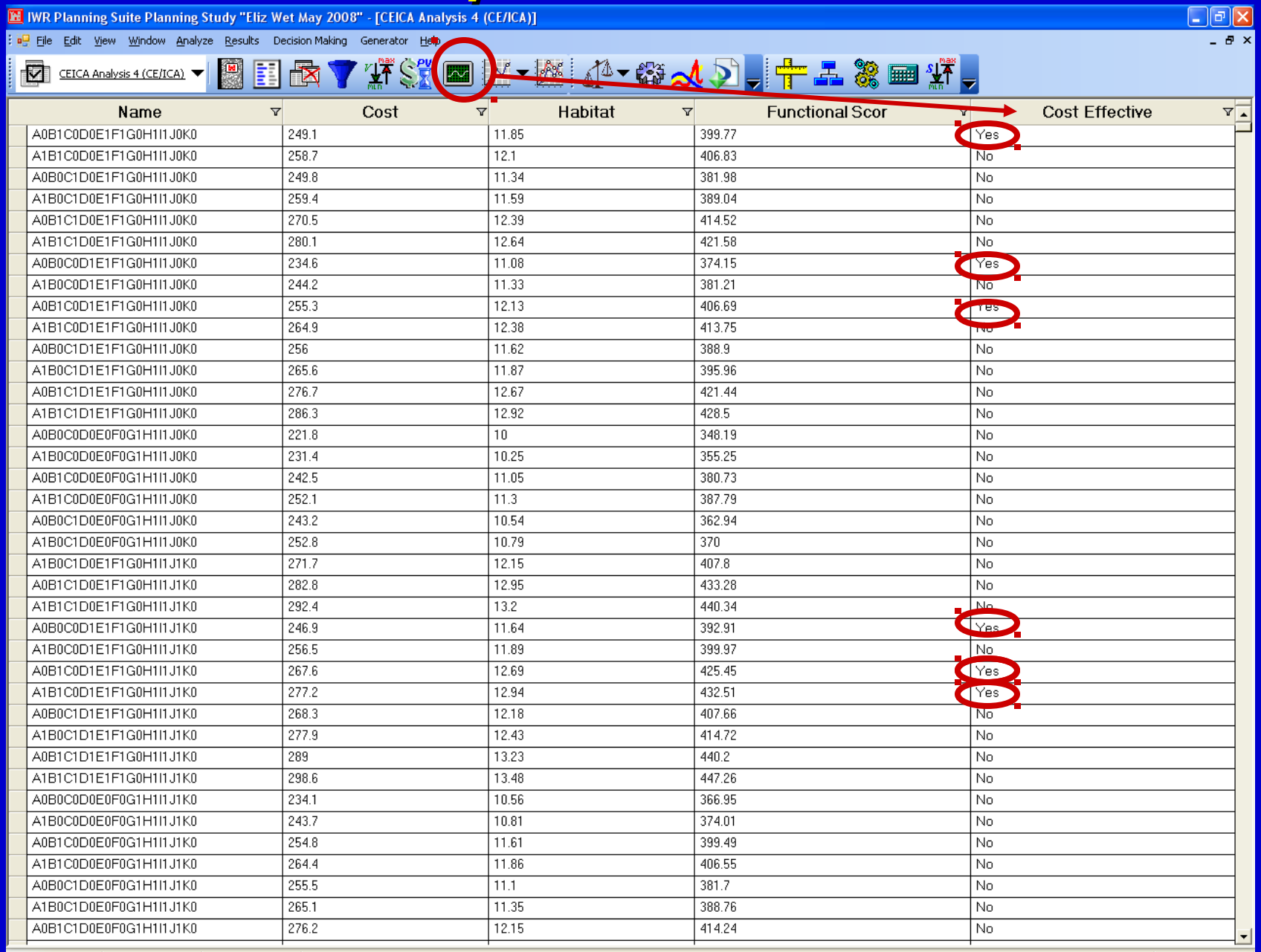

CE/ICA Menu and Toolbar Items
CE/ICA Analysis
Multi Planning Set Results
Reports & Graphs
Planning Set Properties
IWR Planning Suite Planning Study "Planning Study 10" - [CEICA Analysis 3 (CE/ICA)]
File Edit View Window Analyze Results Help
CEICA Analysis 3 (CE/ICA)
Name Costs CWRiparian OpenWater TotalOutput Wetlands Cost Effective
No Action Plan 0 0 0 Best Buy
Locally Preferred Pl 661 No
F1O2S0R0W0I0 1281 No
F2O2S0R0W0I0 1403 No
F3O2S0R0W0I0 1469 Yes
F1O3S0R0W0I0 1476 No
F2O3S0R0W0I0 1598 No
F3O3S0R0W0I0 1664 Yes
F1O4S0R0W0I0 1671 No
F2O4S0R0W0I0 1793 No
F3O4S0R0W0I0 1859 Best Buy
F0O0S1R0W0I0 3490 No
F1O0S1R0W0I0 4141 No
F2O0S1R0W0I0 4263 No
F3O0S1R0W0I0 4329 No
F0O1S1R0W0I0 3905 No
F0O2S1R0W0I0 4110 4185 75 No
F0O3S1R0W0I0 4305 0 4405 100 No
Planning Set Properties
Name CEICA Analysis 3
Description Planning set generated by Cost Effective/Incremental Cost Analysis.
Parent set Generated Set 2
Created By IWR-Plan CE/ICA Analyzer Version 1.0
Parameters
Parameter Variable For Value
Cost Variable Costs
Output Variable Wetlands
OK Cancel
8400 Plans
Planning Set Properties...
4/11/2006

IWR Planning Suite

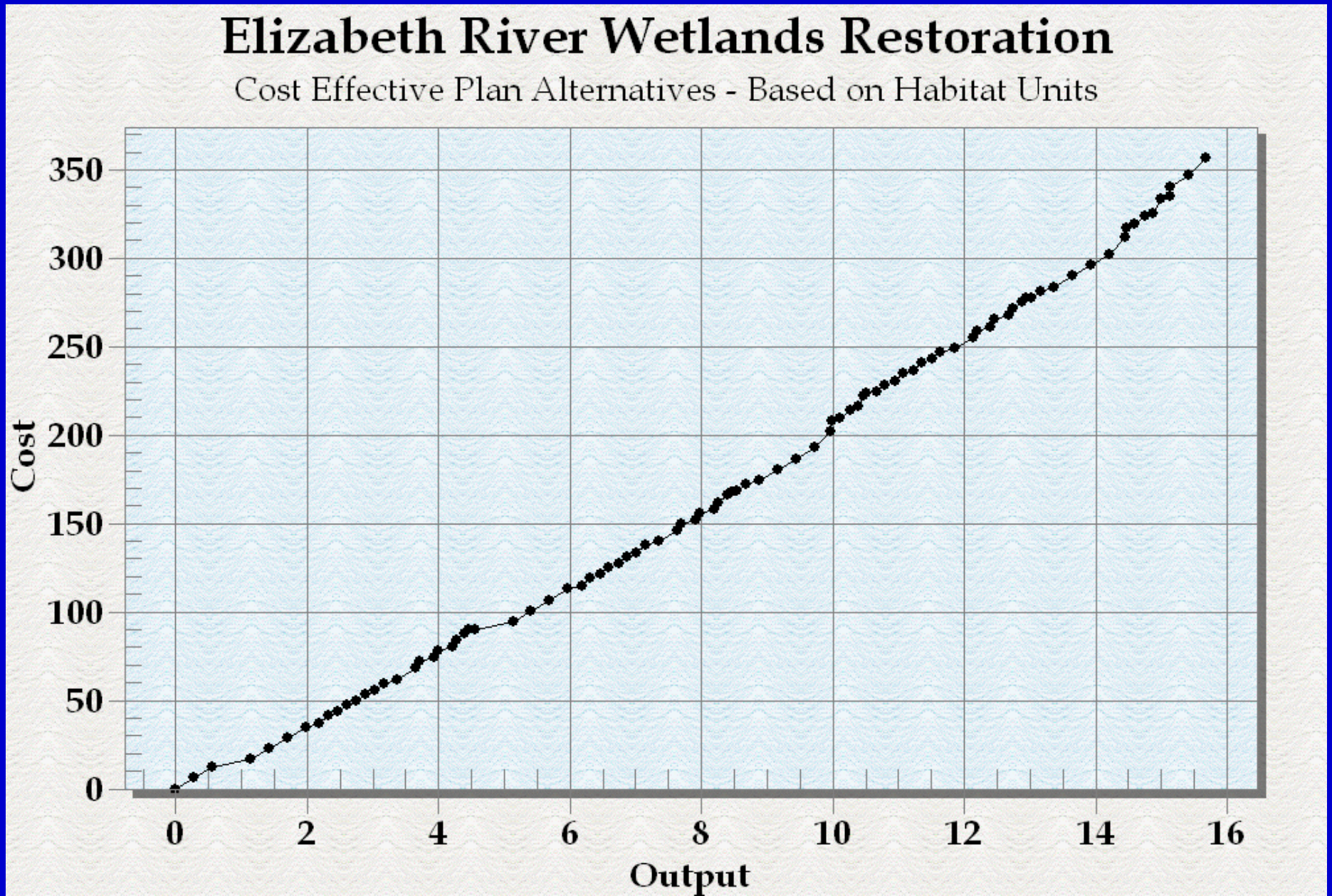
Perform CE/ICA: Wetlands Restoration - HEP



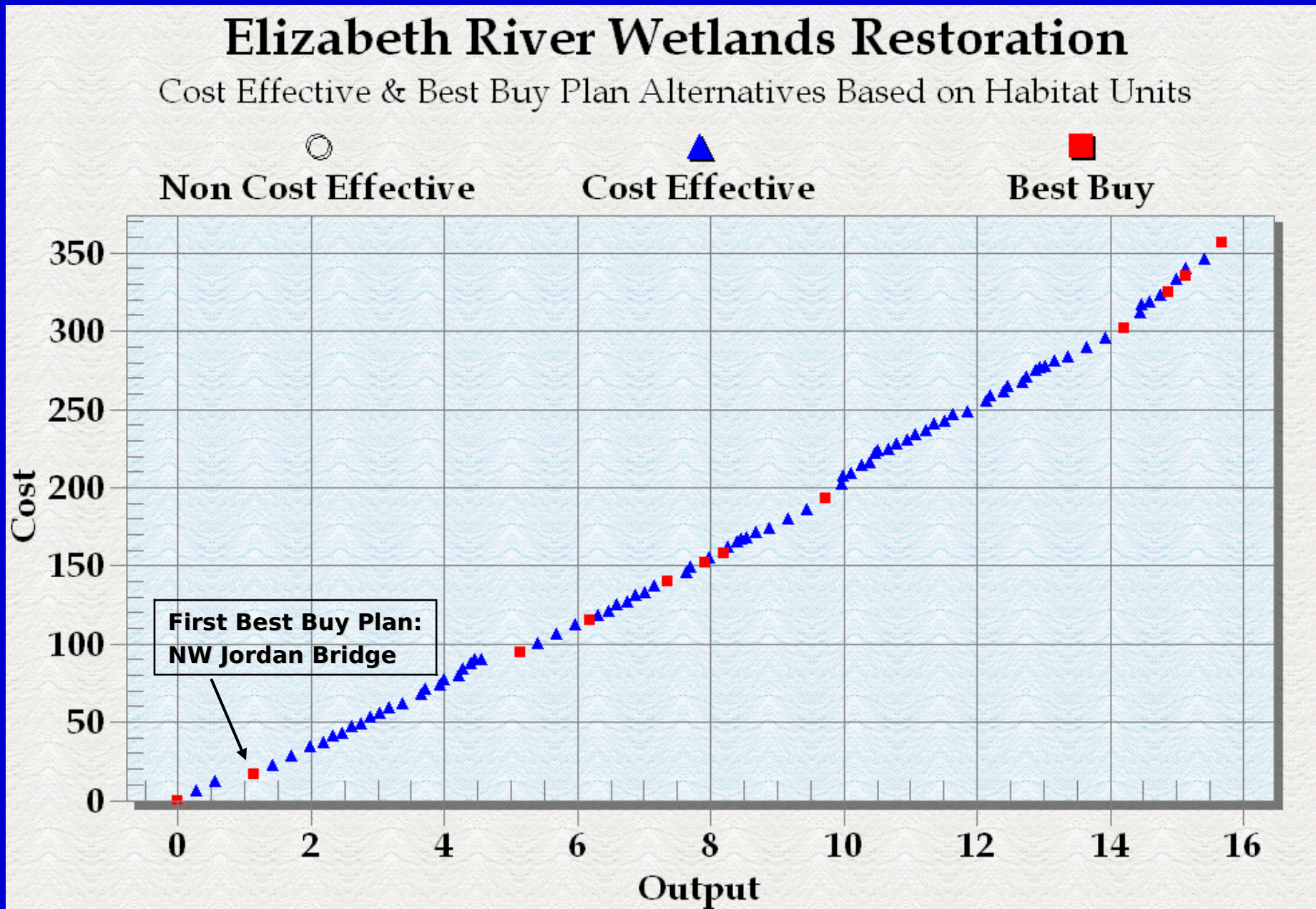
Perform CE/ICA: Wetlands Restoration - HEP



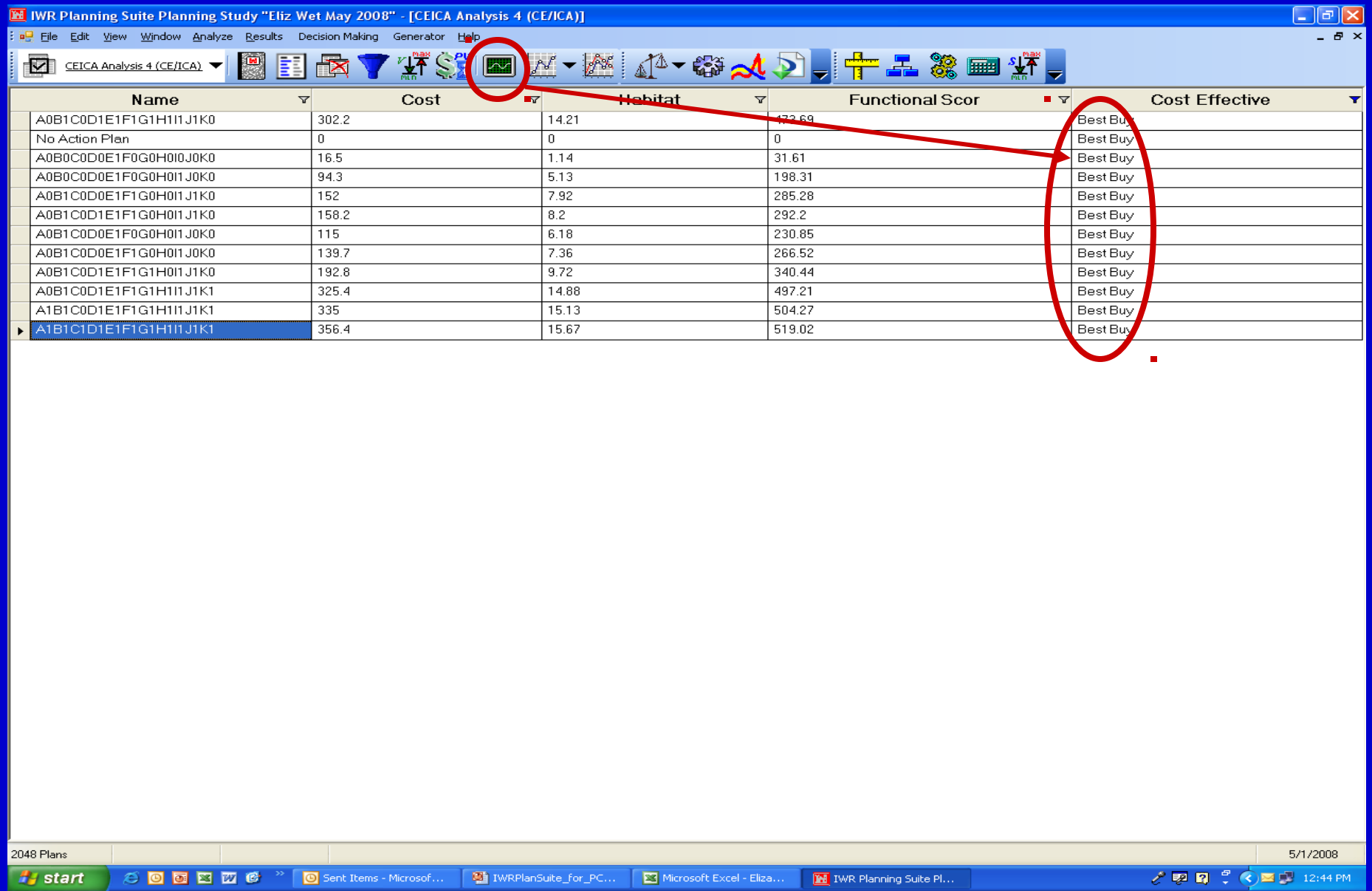
Cost Effectiveness Analysis (92 CE Plans)



Cost Effective & Best Buy Plans

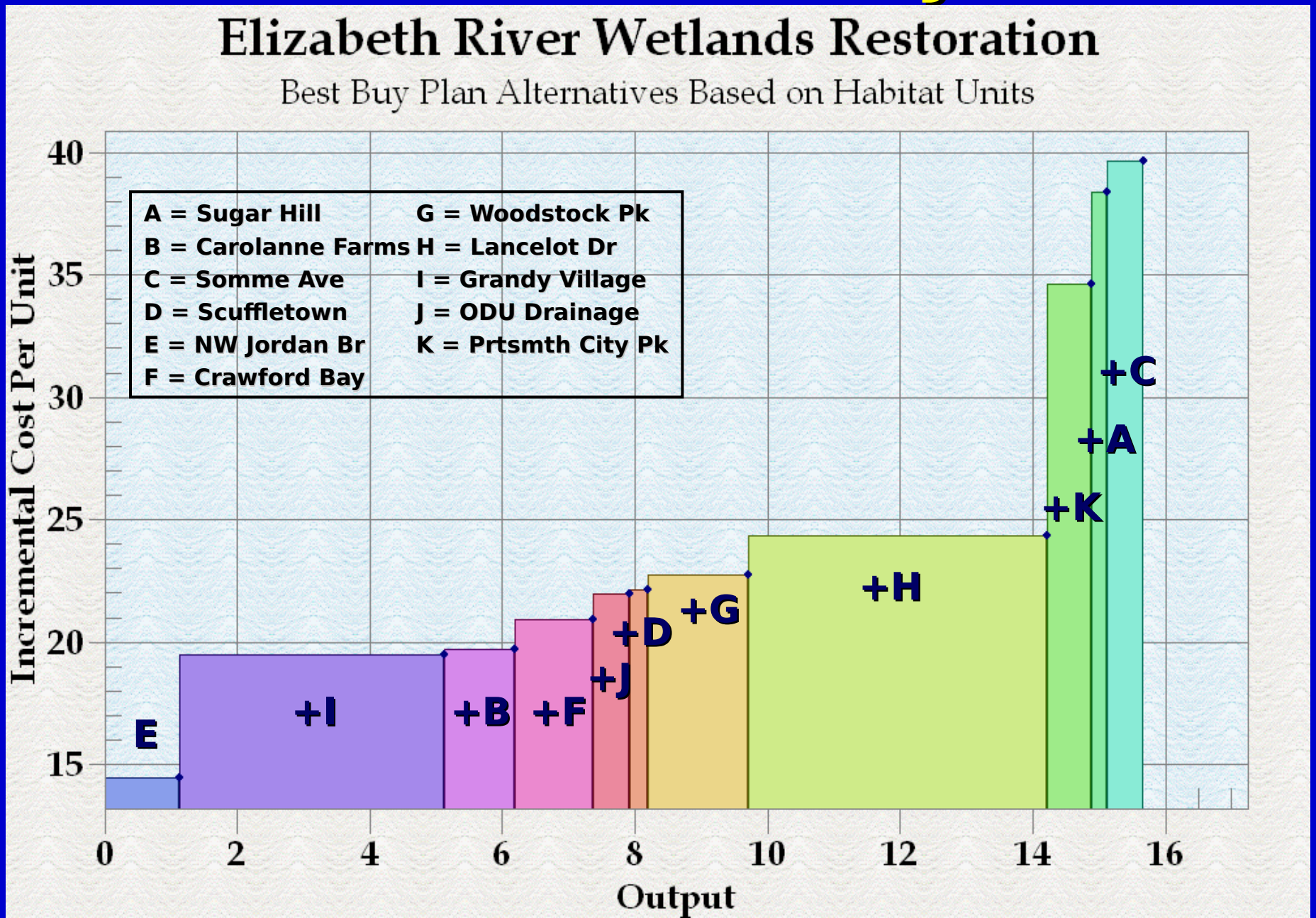


Perform CE/ICA: Wetlands Restoration - HEP


IWR Planning Suite Planning Study "Eliz Wet May 2008" - [CEICA Analysis 4 (CE/ICA)]
File Edit View Window Analyze Results Decision Making Generator Help
CEICA Analysis 4 (CE/ICA)
2048 Plans
5/1/2008
start
Sent Items - Microsof...
IWRPlanSuite_for_PC...
Microsoft Excel - Eliza...
IWR Planning Suite Pl...
12:44 PM

Name	Cost	Habitat	Functional Scor	Cost Effective
A0B1C0D1E1F1G1H1I1J1K0	302.2	14.21	473.69	Best Buy
No Action Plan	0	0	0	Best Buy
A0B0C0D0E1F0G0H0I0J0K0	16.5	1.14	31.61	Best Buy
A0B0C0D0E1F0G0H0I1J0K0	94.3	5.13	198.31	Best Buy
A0B1C0D0E1F1G0H0I1J1K0	152	7.92	285.28	Best Buy
A0B1C0D1E1F1G0H0I1J1K0	158.2	8.2	292.2	Best Buy
A0B1C0D0E1F0G0H0I1J0K0	115	6.18	230.85	Best Buy
A0B1C0D0E1F1G0H0I1J0K0	139.7	7.36	266.52	Best Buy
A0B1C0D1E1F1G1H0I1J1K0	192.8	9.72	340.44	Best Buy
A0B1C0D1E1F1G1H1I1J1K1	325.4	14.88	497.21	Best Buy
A1B1C0D1E1F1G1H1I1J1K1	335	15.13	504.27	Best Buy
A1B1C1D1E1F1G1H1I1J1K1	356.4	15.67	519.02	Best Buy

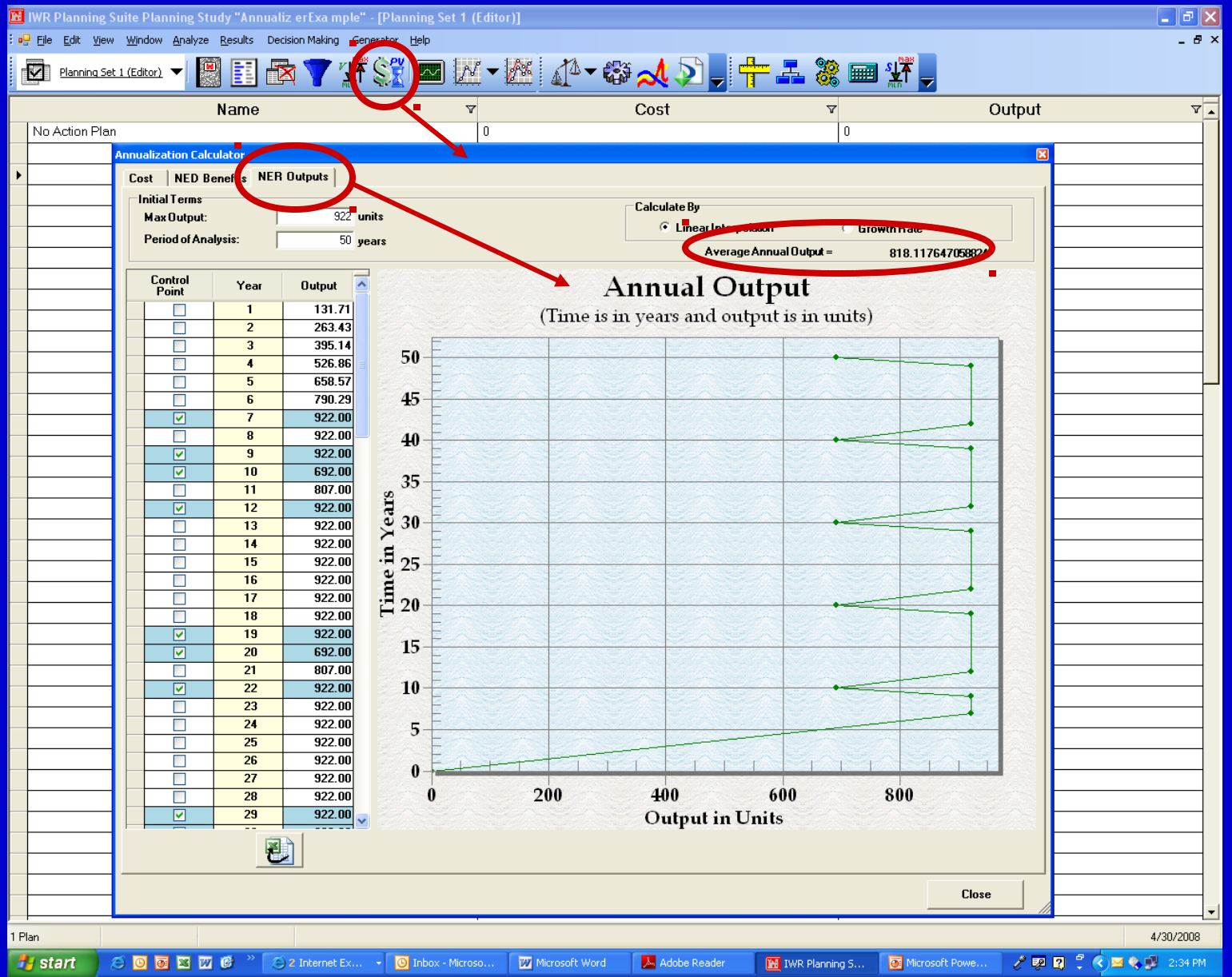
Incremental Cost Analysis (11 Best Buys)



ER 1105-2-100
(22 April 2000)

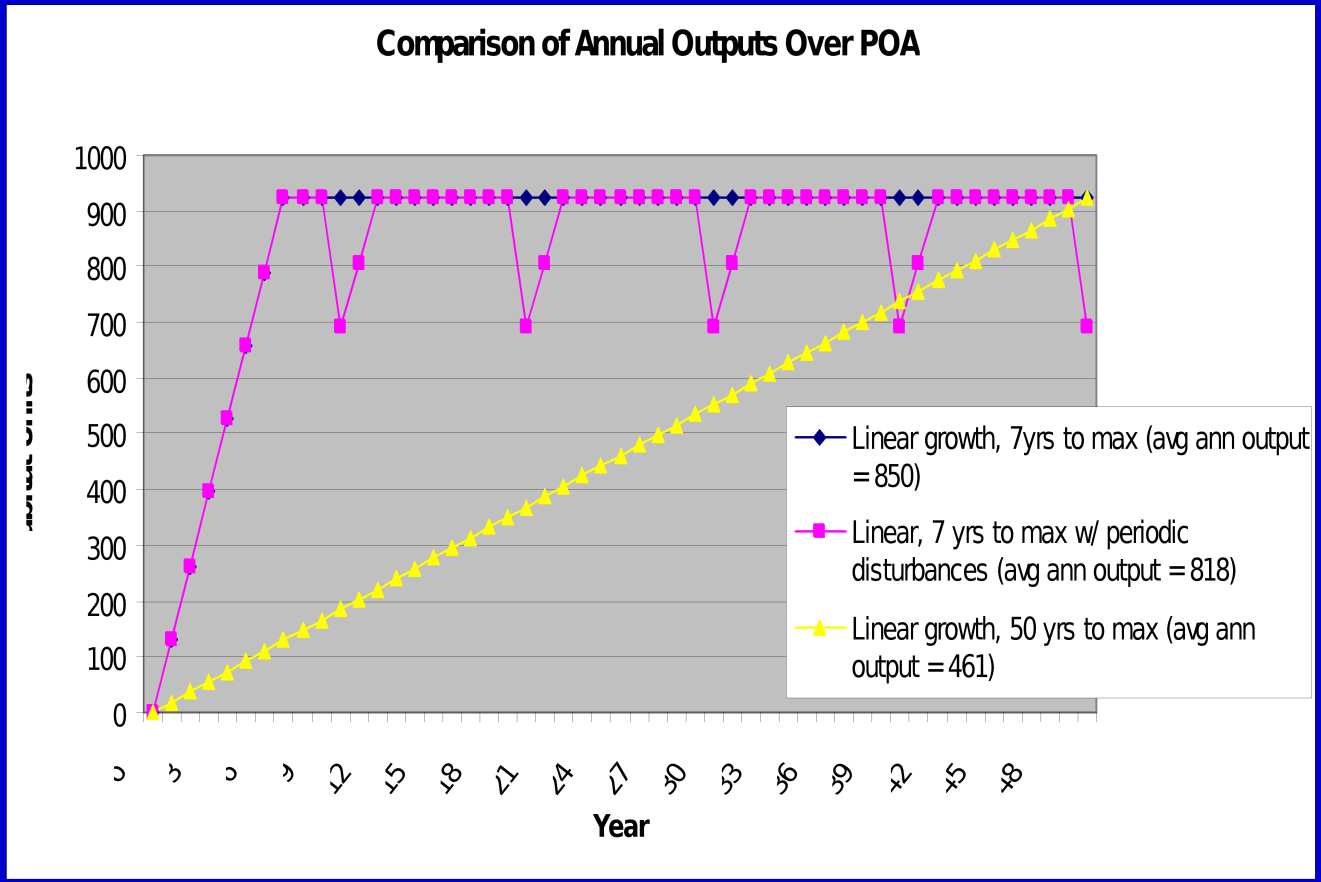
- "Selecting the NER plan requires careful consideration of the plan that meets **planning objectives and constraints** and reasonably maximizes environmental benefits while passing tests of **cost effectiveness and incremental cost analyses**, **significance** of outputs, **acceptability**, **completeness**, **efficiency**, and **effectiveness**." (Appendix E, E-41)

IWR Planning Suite Annualizer Module

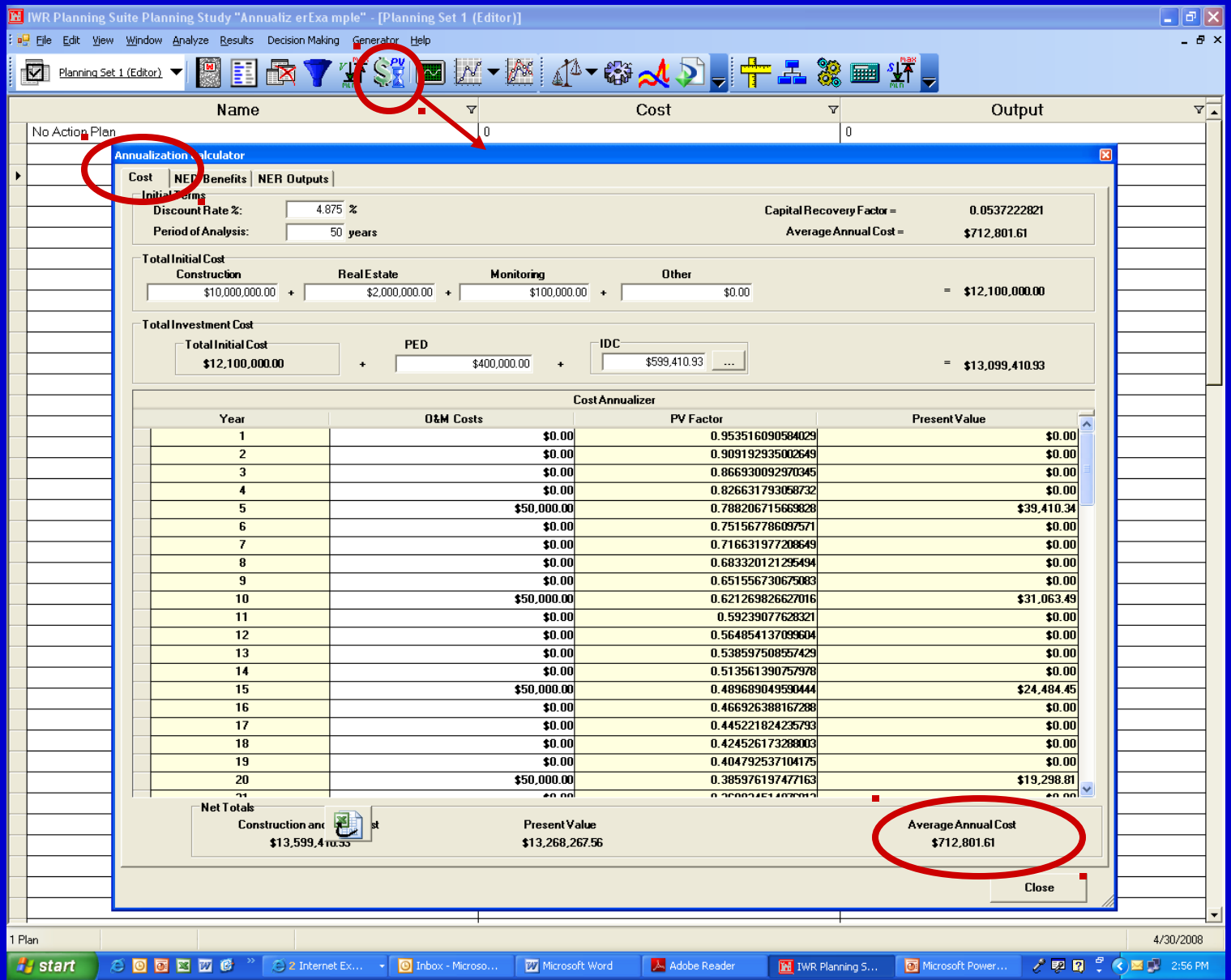


IWR Planning Suite Annualizer Module

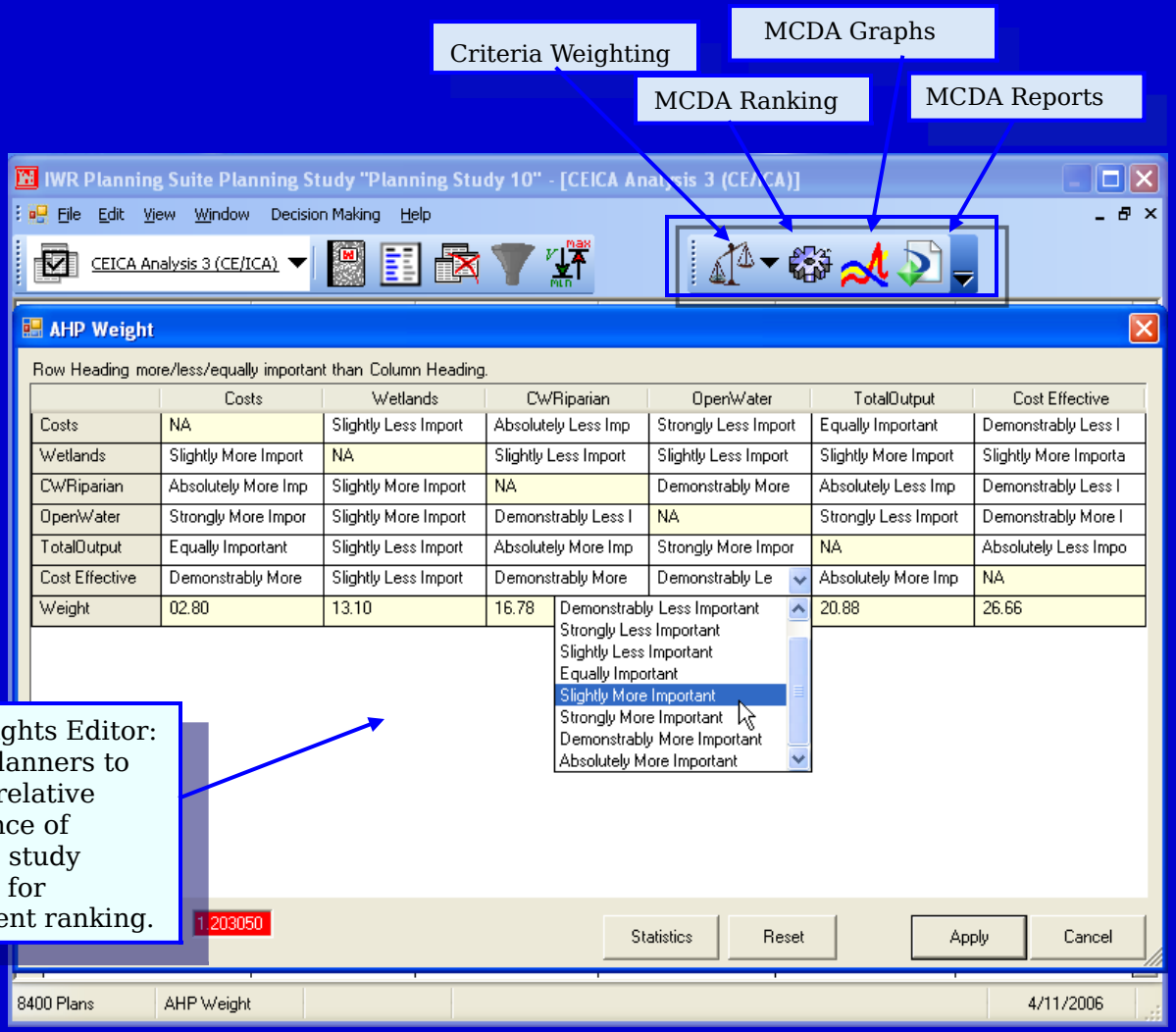
- Can address various assumptions regarding ecological response rates, disturbances, etc., that affect average annual outputs
- Can display for different alternatives how max output levels, & outputs over time, vary



IWR Planning Suite Annualizer Module



IWR Planning Suite MCDA Module


Criteria Weighting
MCDA Graphs
MCDA Ranking
MCDA Reports
IWR Planning Suite Planning Study "Planning Study 10" - [CEICA Analysis 3 (CE/ICA)]
File Edit View Window Decision Making Help
CEICA Analysis 3 (CE/ICA)
AHP Weight
Row Heading more/less/equally important than Column Heading.
Costs Wetlands CWRiparian OpenWater TotalOutput Cost Effective
Costs NA Slightly Less Import Absolutely Less Imp Strongly Less Import Equally Important Demonstrably Less I
Wetlands Slightly More Import NA Slightly Less Import Slightly Less Import Slightly More Import Slightly More Importa
CWRiparian Absolutely More Imp Slightly More Import NA Demonstrably More Absolutely Less Imp Demonstrably Less I
OpenWater Strongly More Impor Slightly More Import Demonstrably Less I NA Strongly Less Import Demonstrably More I
TotalOutput Equally Important Slightly Less Import Absolutely More Imp Strongly More Impor NA Absolutely Less Impo
Cost Effective Demonstrably More Slightly Less Import Demonstrably More Demonstrably Le Absolutely More Imp NA
Weight 02.80 13.10 16.78 20.88 26.66
Demonstrably Less Important
Strongly Less Important
Slightly Less Important
Equally Important
Slightly More Important
Strongly More Important
Demonstrably More Important
Absolutely More Important
1.203050
Statistics
Reset
Apply
Cancel
8400 Plans
AHP Weight
4/11/2006

AHP Weights Editor: Allows planners to edit the relative importance of planning study criterion for subsequent ranking.

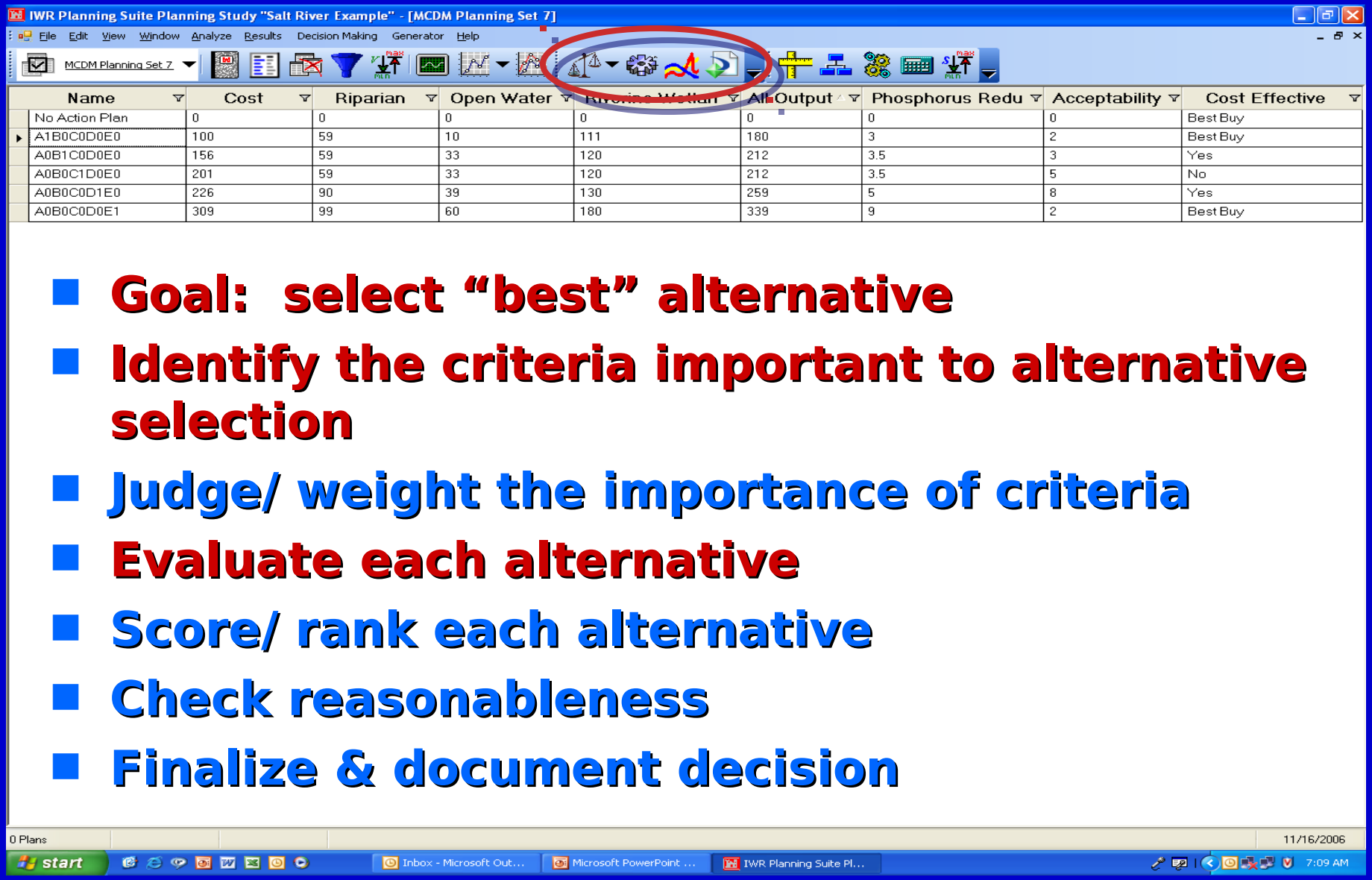
Benefits of Multicriteria Decision Analysis Tools

- Provides 1 framework under which to conduct multi-objective, multi-criteria analyses
- Speedy construction and elucidation of the decision-making process
- Deeper insight into the factors affecting the decision
- Understanding of how sensitive the decision results are to judgments employed
- Illuminates trade-offs
- Collaborative process involved can be as useful as results themselves
  - Can lead to greater consensus and commitment from group members
- Supports rather than replaces decision-making

MCDA Basic Framework – 4 Part Process

1) Create decision matrix
2) Develop weights
3) Score/Rank alternatives
4) Analyze results

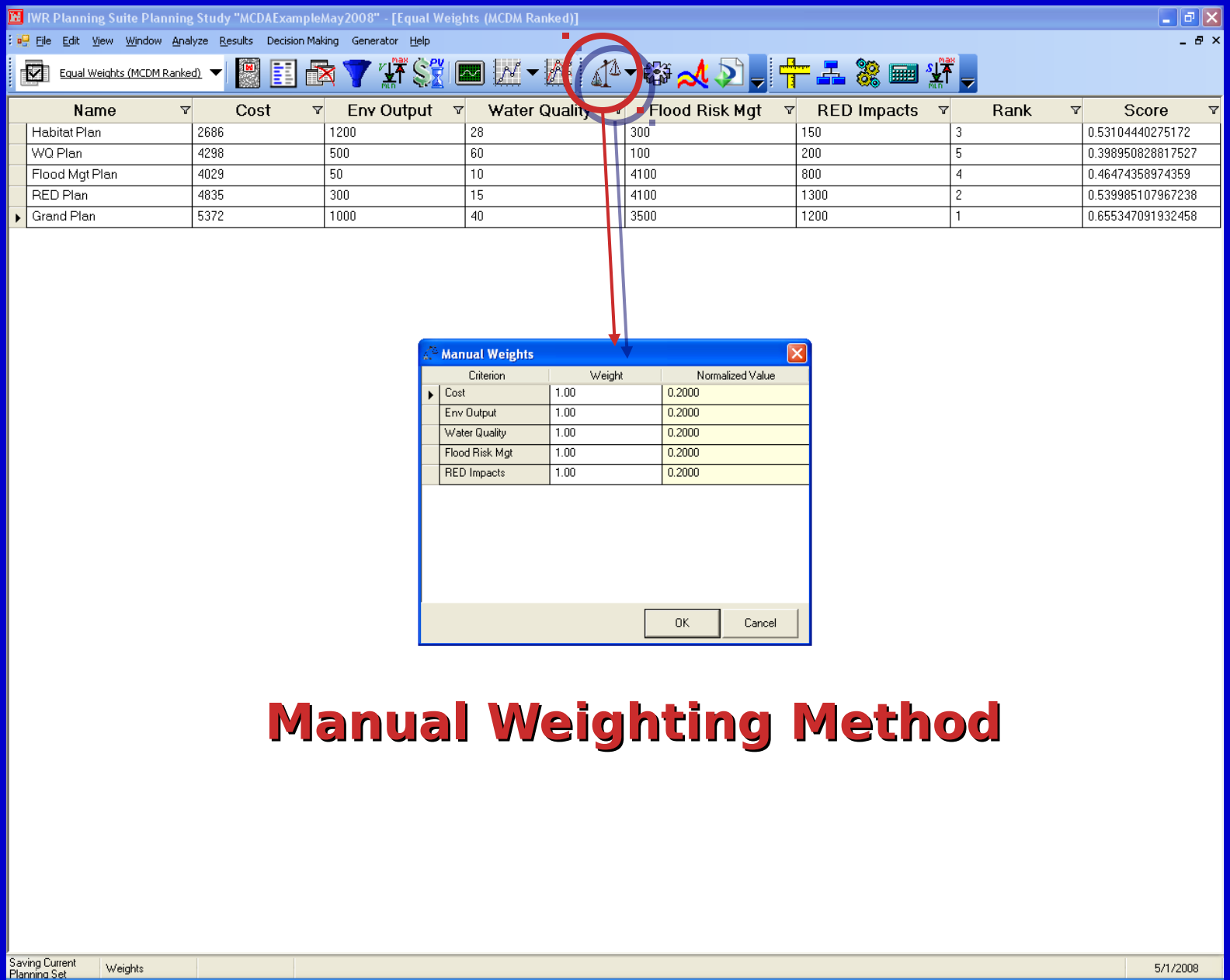
Create Decision Matrix


IWR Planning Suite Planning Study "Salt River Example" - [MCDM Planning Set 7]
File Edit View Window Analyze Results Decision Making Generator Help
MCDM Planning Set 7

Name	Cost	Riparian	Open Water	Riverine Wetlan	Al Output	Phosphorus Redu	Acceptability	Cost Effective
No Action Plan	0	0	0	0	0	0	0	Best Buy
A1B0C0D0E0	100	59	10	111	180	3	2	Best Buy
A0B1C0D0E0	156	59	33	120	212	3.5	3	Yes
A0B0C1D0E0	201	59	33	120	212	3.5	5	No
A0B0C0D1E0	226	90	39	130	259	5	8	Yes
A0B0C0D0E1	309	99	60	180	339	9	2	Best Buy

- **Goal: select "best" alternative**
- **Identify the criteria important to alternative selection**
- **Judge/ weight the importance of criteria**
- **Evaluate each alternative**
- **Score/ rank each alternative**
- **Check reasonableness**
- **Finalize & document decision**

Importance


IWR Planning Suite Planning Study "MCDAExampleMay2008" - [Equal Weights (MCDM Ranked)]
File Edit View Window Analyze Results Decision Making Generator Help
Equal Weights (MCDM Ranked)
Name | Cost | Env Output | Water Quality | Flood Risk Mgt | RED Impacts | Rank | Score
Habitat Plan | 2686 | 1200 | 28 | 300 | 150 | 3 | 0.53104440275172
WQ Plan | 4298 | 500 | 60 | 100 | 200 | 5 | 0.398950828817527
Flood Mgt Plan | 4029 | 50 | 10 | 4100 | 800 | 4 | 0.46474358974359
RED Plan | 4835 | 300 | 15 | 4100 | 1300 | 2 | 0.539985107967238
Grand Plan | 5372 | 1000 | 40 | 3500 | 1200 | 1 | 0.655347091932458
Manual Weights
Criterion | Weight | Normalized Value
Cost | 1.00 | 0.2000
Env Output | 1.00 | 0.2000
Water Quality | 1.00 | 0.2000
Flood Risk Mgt | 1.00 | 0.2000
RED Impacts | 1.00 | 0.2000
OK
Cancel
Saving Current Planning Set
Weights
5/1/2008

Manual Weighting Method

Judge/ Weight Criteria Importance

IWR Planning Suite Planning Study "MCDAExampleMay2008" - [AH

File Edit View Window Analyze Results Decision Making Generator Help

AHP Weights - Cost Strongly/Absolutely More Import (MCDM Ranked)

Name	Cost	Env Output	Water Quality	Flood Risk Mgt	RED Impacts	Rank	Score
Habitat Plan	2686	1200	28	300	150	1	0.78534023764853
WQ Plan	4298	500	60	100	200	3	0.395513472563129
Flood Mgt Plan	4029	50	10	4100	800	2	0.485086538461538
RED Plan	4835	300	15	4100	1300	4	0.357543149664929
Grand Plan	5372	1000	40	3500	1200	5	0.304288242651657

AHP Weight

Row Heading more/less/equally important than Column Heading.

	Cost	Env Output	Water Quality	Flood Risk Mgt	RED Impacts
Cost	NA	Strongly More Important	Absolutely More Importa	Strongly More Important	Absolutely More Importa
Env Output	Strongly Less Important	NA	Equally Important (1)	Equally Important (1)	Equally Important (1)
Water Quality	Absolutely Less Importa	Equally Important (1)	NA	Equally Important (1)	Equally Important (1)
Flood Risk Mgt	Strongly Less Important	Equally Important (1)	Equally Important (1)	NA	Equally Important (1)
RED Impacts	Absolutely Less Importa	Equally Important (1)	Equally Important (1)	Equally Important (1)	NA
Weight	62.92	09.82	08.72	09.82	08.72

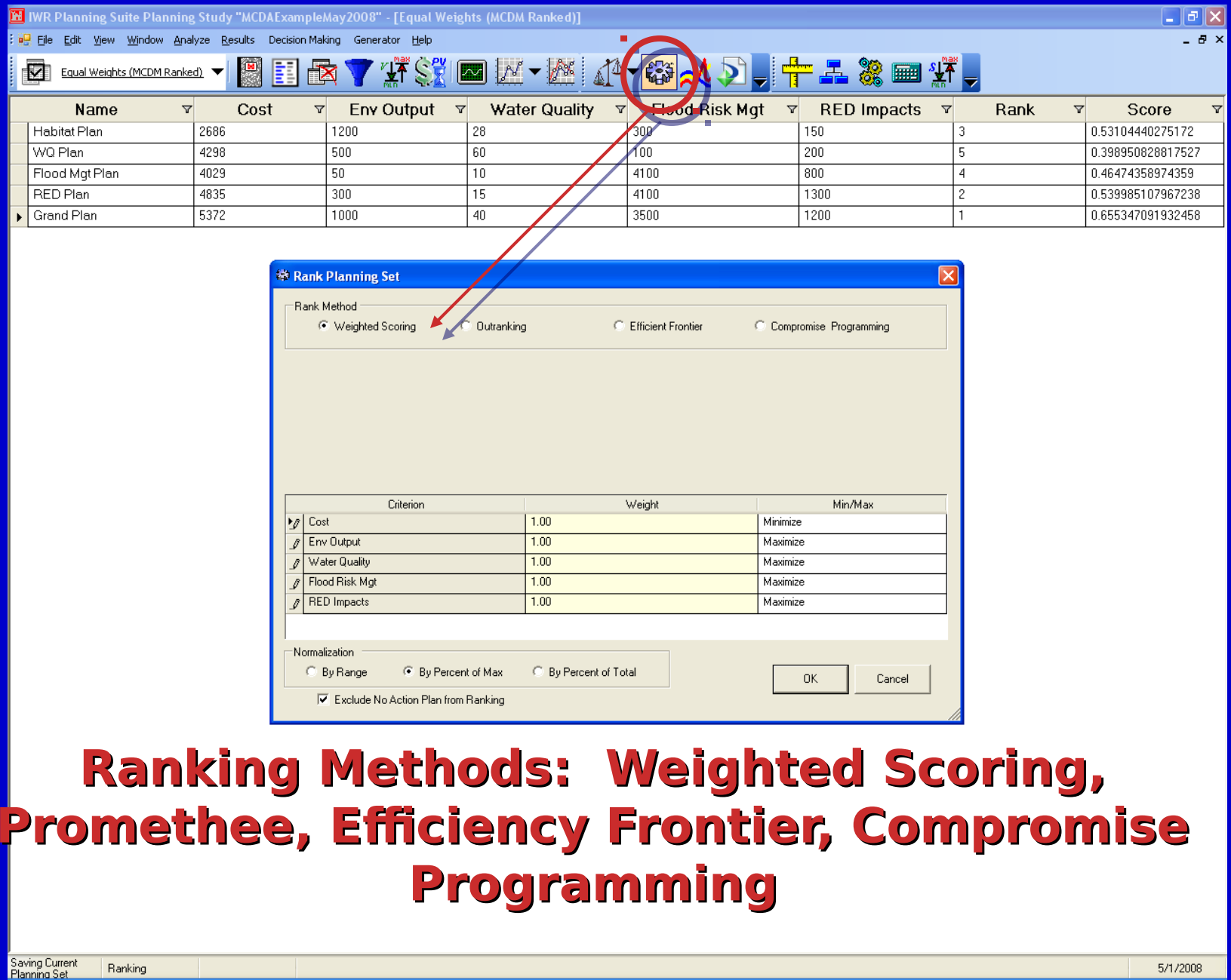
Inconsistency Ratio: 0.012420

Help Statistics Reset Apply Cancel

Saving Current Planning Set | AHP Weight | 5/1/2008

Analytic Hierarchy Process (AHP) Method

Score/ Rank Alternatives


IWR Planning Suite Planning Study "MCDAExampleMay2008" - [Equal Weights (MCDM Ranked)]
File Edit View Window Analyze Results Decision Making Generator Help
Equal Weights (MCDM Ranked)
Name | Cost | Env Output | Water Quality | Flood Risk Mgt | RED Impacts | Rank | Score
Habitat Plan | 2686 | 1200 | 28 | 300 | 150 | 3 | 0.53104440275172
WQ Plan | 4298 | 500 | 60 | 100 | 200 | 5 | 0.398950828817527
Flood Mgt Plan | 4029 | 50 | 10 | 4100 | 800 | 4 | 0.46474358974359
RED Plan | 4835 | 300 | 15 | 4100 | 1300 | 2 | 0.539985107967238
Grand Plan | 5372 | 1000 | 40 | 3500 | 1200 | 1 | 0.655347091932458
Rank Planning Set
Rank Method
Weighted Scoring
Outranking
Efficient Frontier
Compromise Programming
Criterion | Weight | Min/Max
Cost | 1.00 | Minimize
Env Output | 1.00 | Maximize
Water Quality | 1.00 | Maximize
Flood Risk Mgt | 1.00 | Maximize
RED Impacts | 1.00 | Maximize
Normalization
By Range
By Percent of Max
By Percent of Total
OK
Cancel
Exclude No Action Plan from Ranking
Saving Current Planning Set
Ranking
5/1/2008

Ranking Methods: Weighted Scoring, Promethee, Efficiency Frontier, Compromise Programming

Score/ Rank Alternatives

- **Weighted Scoring:**
  - Most “intuitive”
  - Scores between 0 & 1
  - Normalize by % of maximum, % of total, or % of range
- **Promethee:**
  - “Preference ranking organization method for enrichment evaluations”
  - Outranking (which alts outrank others)
  - User can specify preference functions (strict/absolute, threshold, step, linear over range, linear with threshold)
  - Negative scores possible
- **Efficiency Frontier**
  - Dominated/ non-dominated alternatives
  - Score of 0 or 1
- **Compromise Programming**
  - Measures “distance from ideal” on multiple criteria
  - “Ideal” alt identified for each criterion; Ideal alt constructed w/ best value for each criterion; values normalized; use distance function to find least distance to ideal
  - Lowest score (least distance from ideal) is superior

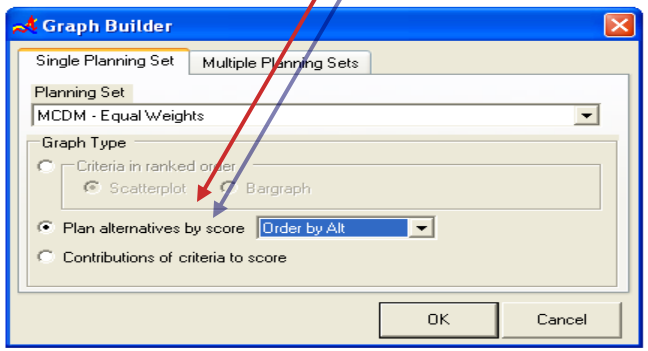
Display Graphical Results

IWR Planning Suite Planning Study "MCDAExampleMay2008" - [MCDM - Equal Weights (MCDM Ranked)]

File Edit View Window Analyze Results Decision Making Generator Help

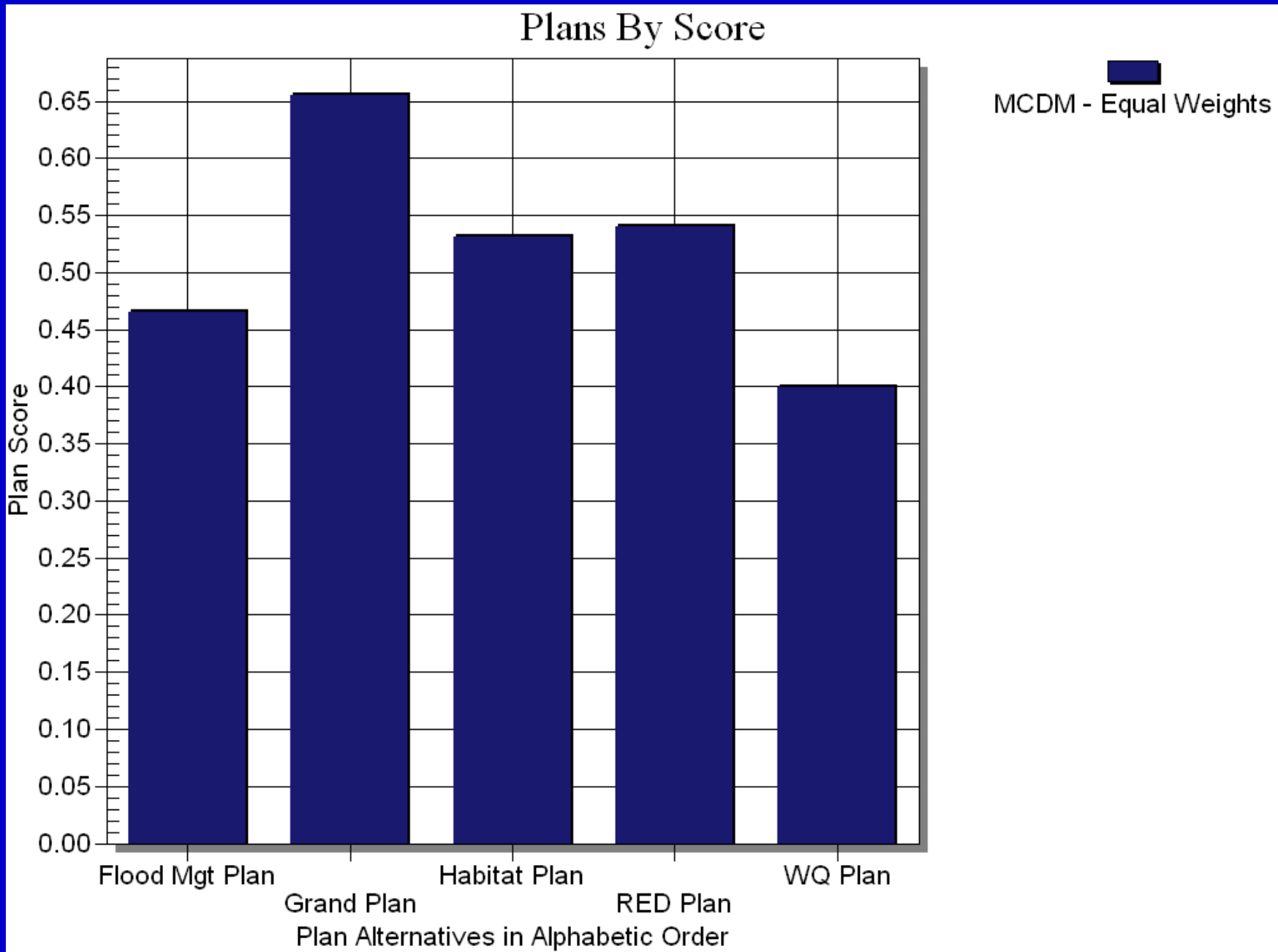
MCDM - Equal Weights (MCDM Ranked)

Name	Cost	Env Output	Water Quality	Flood Risk Mgt	RED Impacts	Rank	Score
Habitat Plan	2686	1200	28	300	150	3	0.53104440275172
WQ Plan	4298	500	60	100	200	5	0.398950828817527
Flood Mgt Plan	4029	50	10	4100	800	4	0.46474358974359
RED Plan	4835	300	15	4100	1300	2	0.539985107967238
Grand Plan	5372	1000	40	3500	1200	1	0.655347091932458

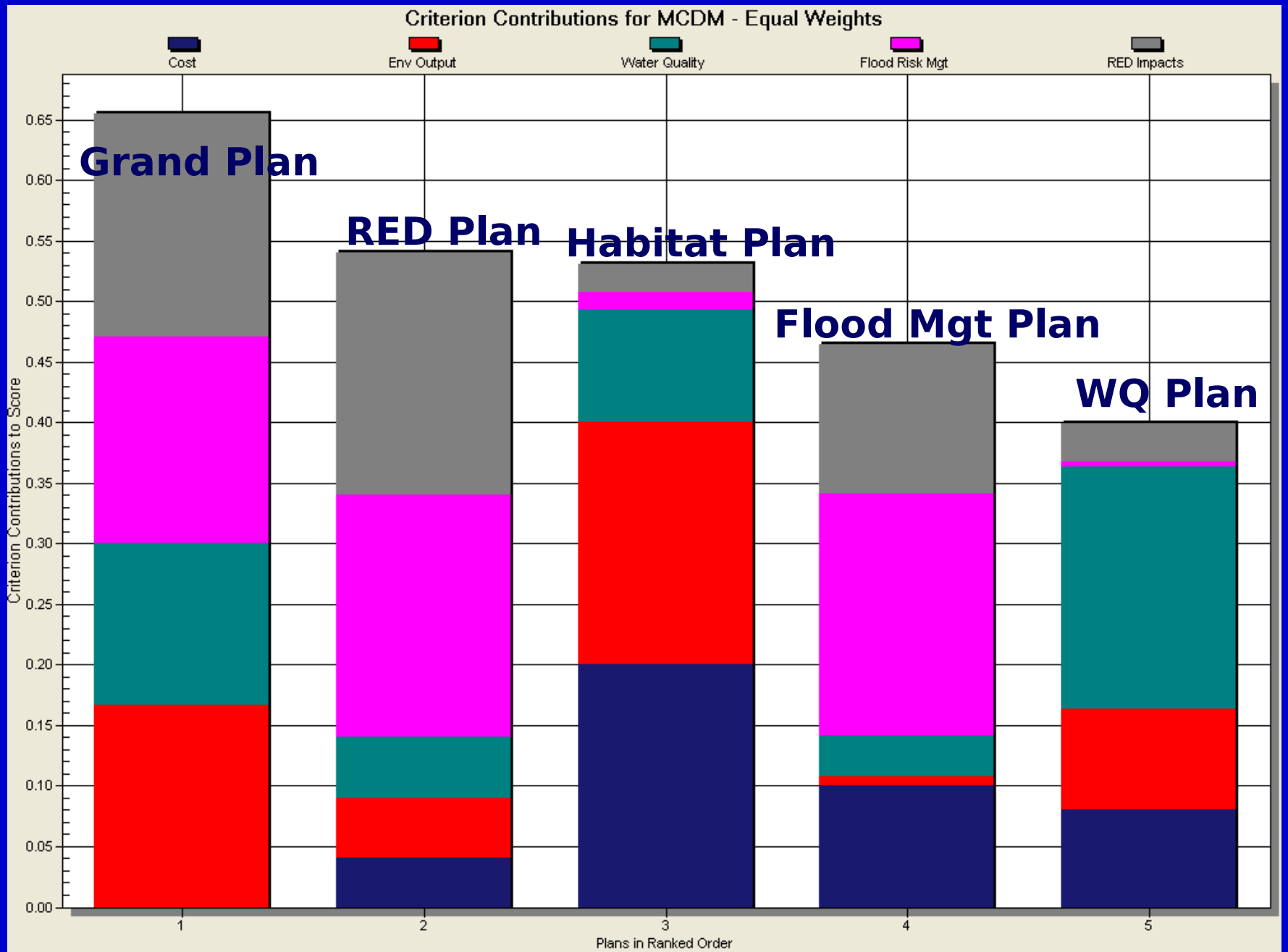


Saving Current Planning Set | Graphs | 5/1/2008

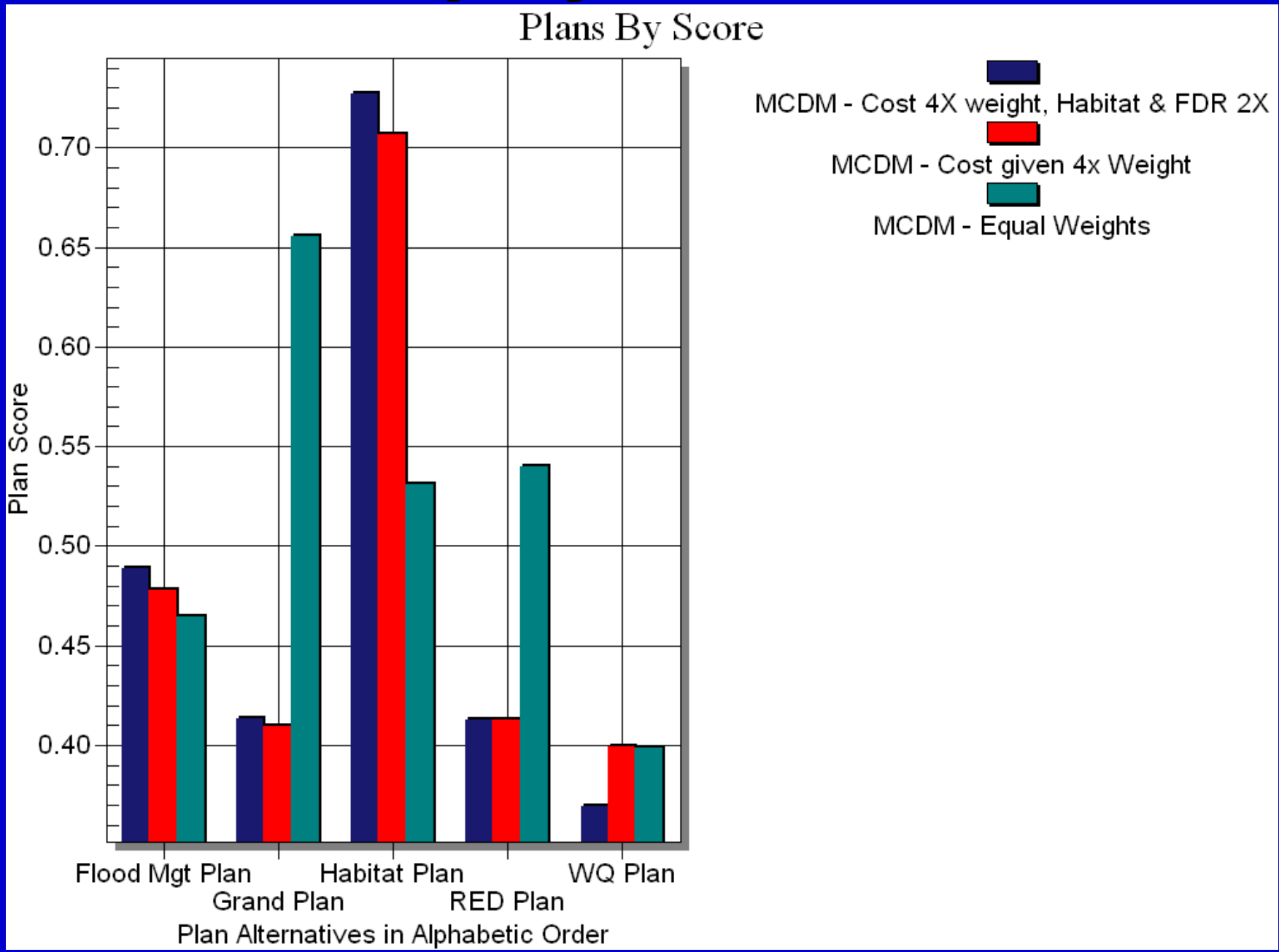
Display Results



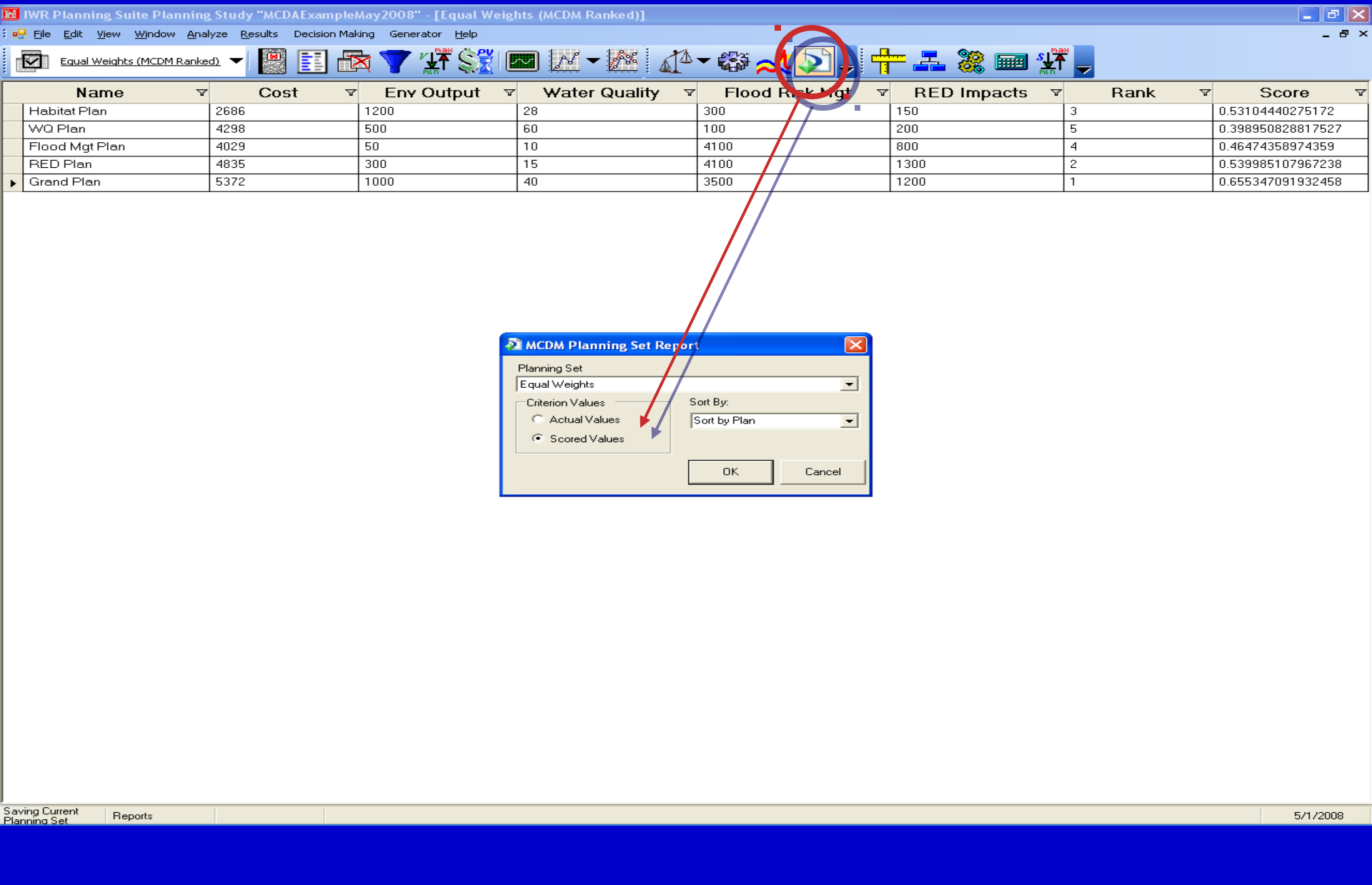
Display Results



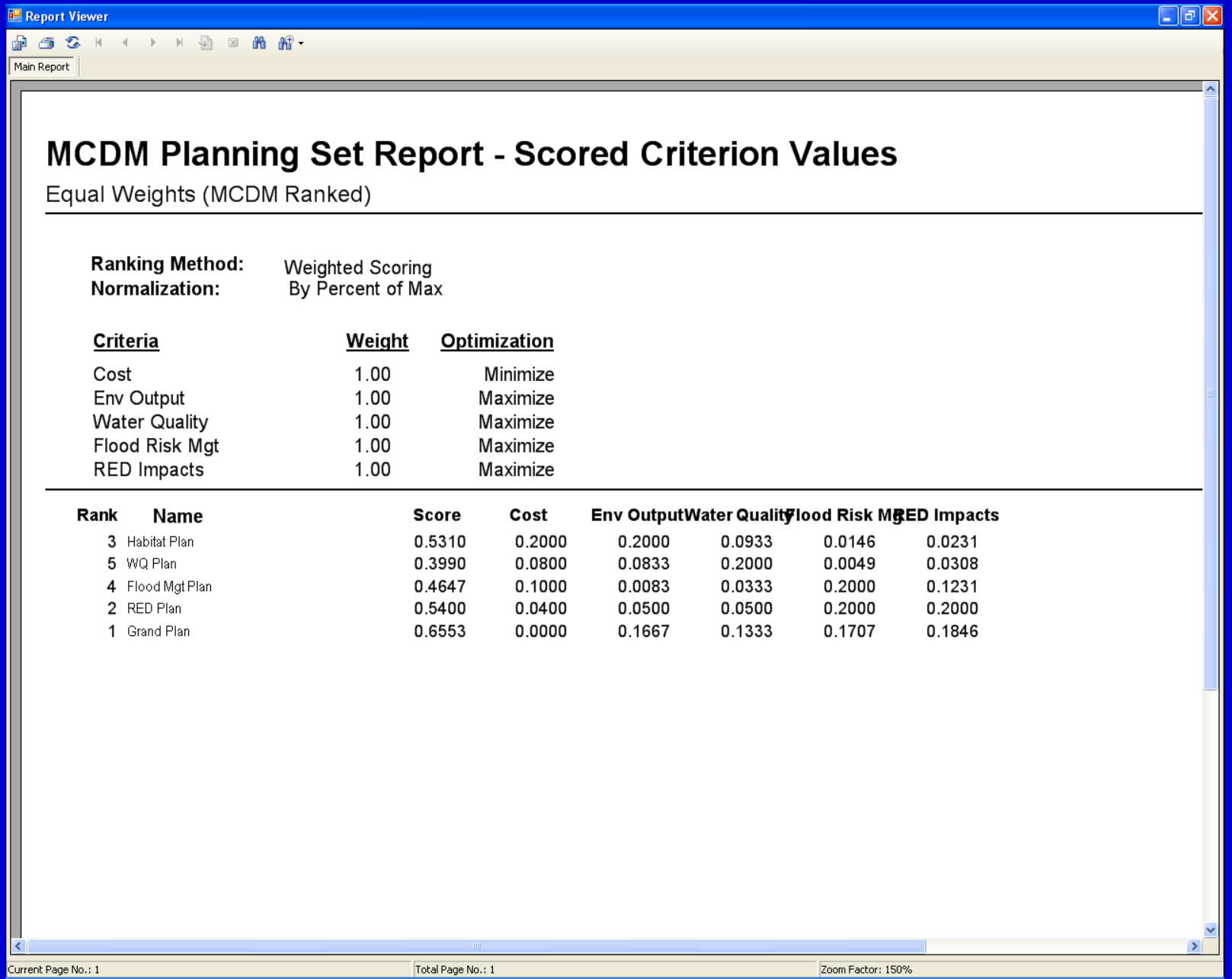
Display Results



Display Report Results


IWR Planning Suite Planning Study "MCDAExampleMay2008" - [Equal Weights (MCDM Ranked)]
File Edit View Window Analyze Results Decision Making Generator Help
Equal Weights (MCDM Ranked)
Name | Cost | Env Output | Water Quality | Flood Risk Mgt | RED Impacts | Rank | Score
Habitat Plan | 2686 | 1200 | 28 | 300 | 150 | 3 | 0.53104440275172
WQ Plan | 4298 | 500 | 60 | 100 | 200 | 5 | 0.398950828817527
Flood Mgt Plan | 4029 | 50 | 10 | 4100 | 800 | 4 | 0.46474358974359
RED Plan | 4835 | 300 | 15 | 4100 | 1300 | 2 | 0.539985107967238
Grand Plan | 5372 | 1000 | 40 | 3500 | 1200 | 1 | 0.655347091932458
MCDM Planning Set Report
Planning Set
Equal Weights
Criterion Values
Actual Values
Scored Values
Sort By:
Sort by Plan
OK
Cancel
Saving Current Planning Set
Reports
5/1/2008

Display Results

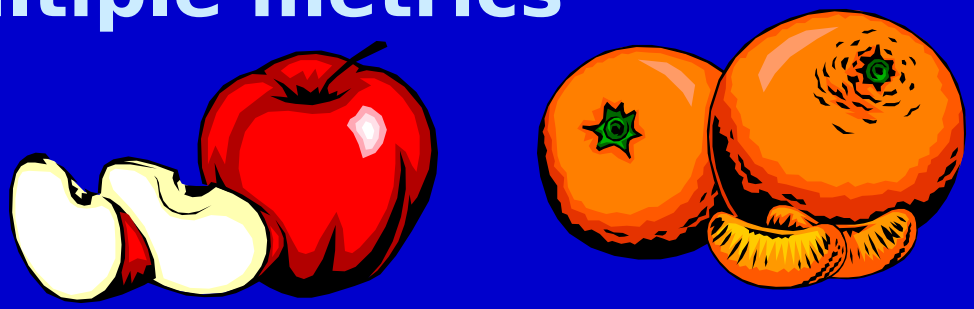

Report Viewer
Main Report
MCDM Planning Set Report - Scored Criterion Values
Equal Weights (MCDM Ranked)
Ranking Method: Weighted Scoring
Normalization: By Percent of Max
Criteria Weight Optimization
Cost 1.00 Minimize
Env Output 1.00 Maximize
Water Quality 1.00 Maximize
Flood Risk Mgt 1.00 Maximize
RED Impacts 1.00 Maximize
Rank Name Score Cost Env Output Water Quality Flood Risk Mgt RED Impacts
3 Habitat Plan 0.5310 0.2000 0.2000 0.0933 0.0146 0.0231
5 WQ Plan 0.3990 0.0800 0.0833 0.2000 0.0049 0.0308
4 Flood Mgt Plan 0.4647 0.1000 0.0083 0.0333 0.2000 0.1231
2 RED Plan 0.5400 0.0400 0.0500 0.0500 0.2000 0.2000
1 Grand Plan 0.6553 0.0000 0.1667 0.1333 0.1707 0.1846
Current Page No.: 1
Total Page No.: 1
Zoom Factor: 150%

Applicability

- Restoration and mitigation
- All scopes of problems
- All types of resources
  - HU's, acres, river miles, IBI
- All scales of projects
- All phases of work
- Many agencies and interests

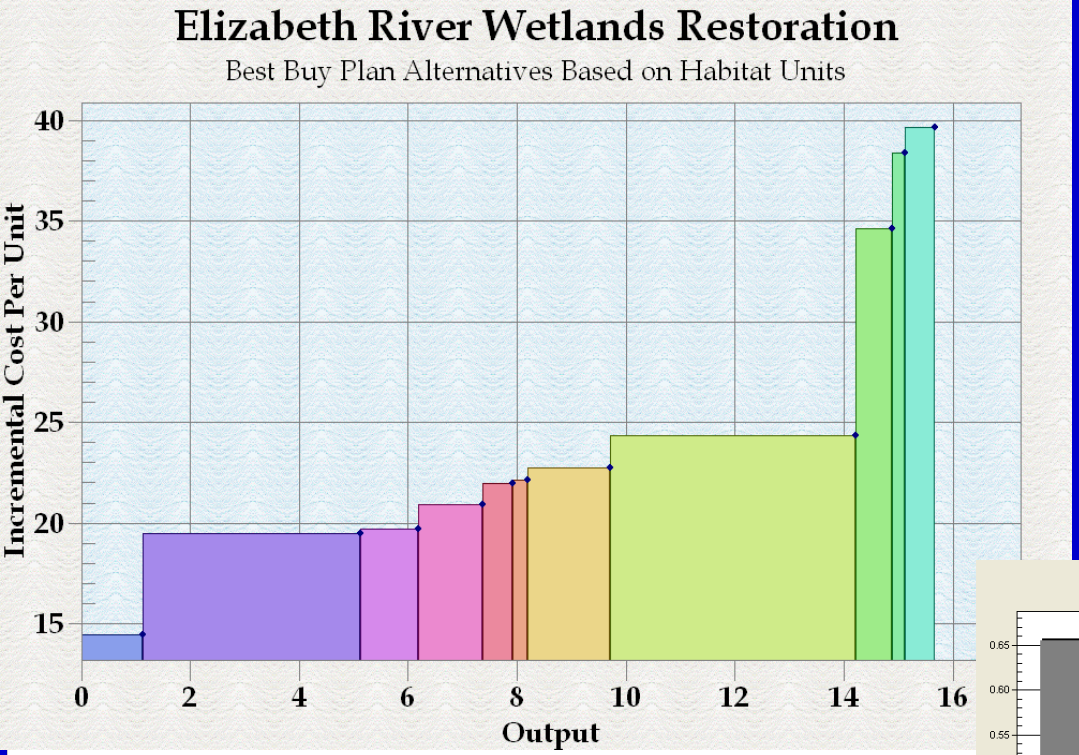
Challenges

- K.I.S.S. - don’t go too fast too soon
- Set-up - getting started
- Output quantification
- Commensuration
  - Multiple metrics

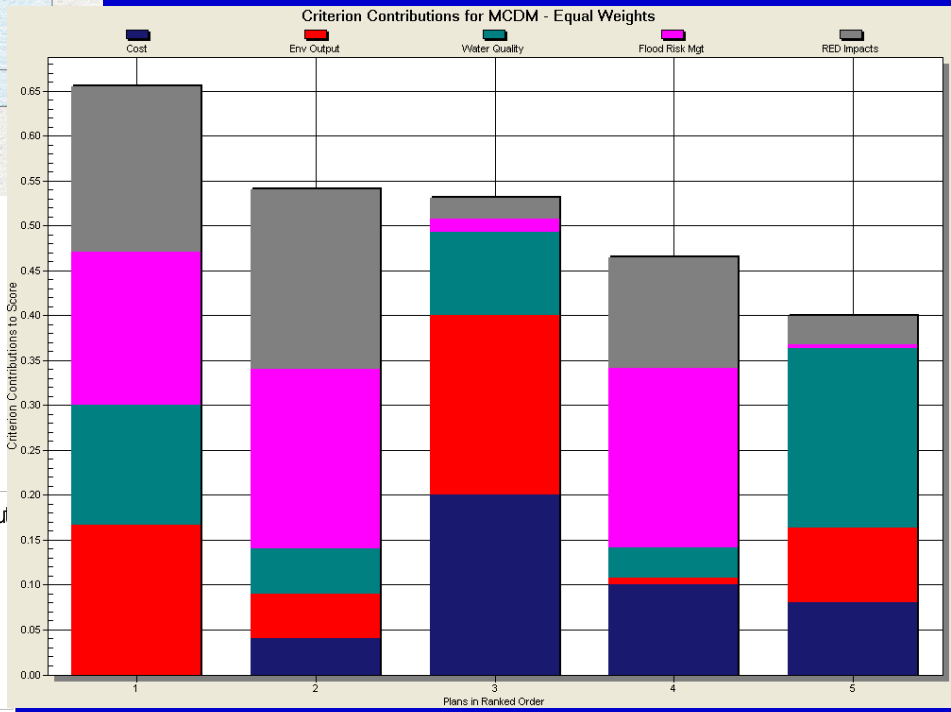


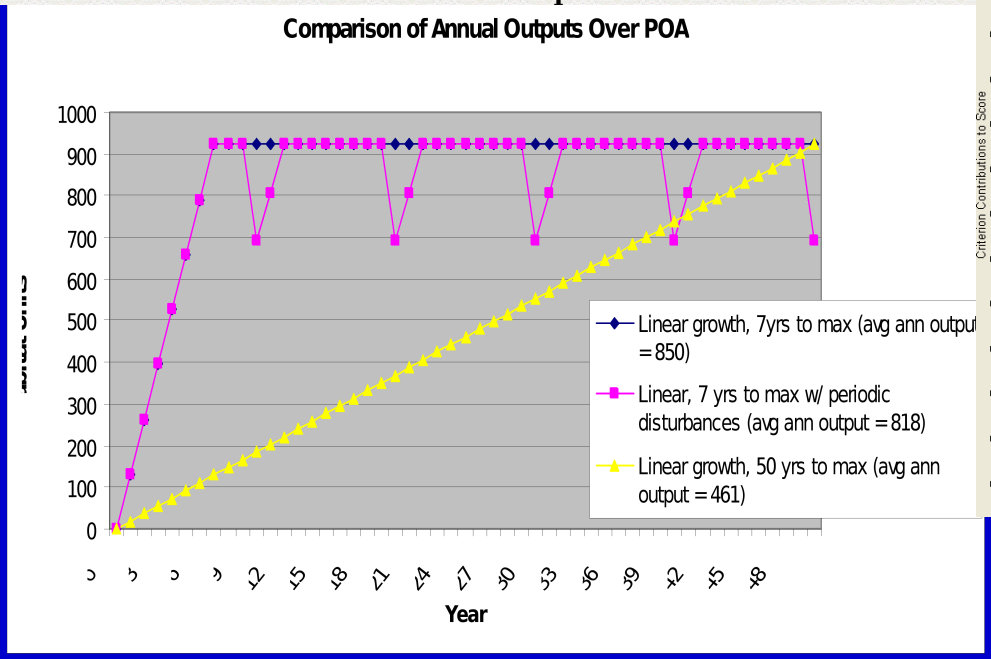
Benefits

- **Flexibility**
  - **Handles various resources & approaches**
  - **From simple to complex**
- **Rational, equitable approach**
- **Saves time**
- **Saves costs**
  - **Greatest “bang for the buck”**
- **Allows you to focus on what’s important**
- **It’s easy**
- **More informed decisions!**


Elizabeth River Wetlands Restoration
Best Buy Plan Alternatives Based on Habitat Units
Incremental Cost Per Unit
40
35
30
25
20
15
0
2
4
6
8
10
12
14
16
Output

Questions ?


Criterion Contributions for MCDM - Equal Weights
Cost
Env Output
Water Quality
Flood Risk Mgt
RED Impacts
Criterion Contributions to Score
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1
2
3
4
5
Plans in Ranked Order


Comparison of Annual Outputs Over POA
1000
900
800
700
600
500
400
300
200
100
0
Linear growth, 7yrs to max (avg ann output = 850)
Linear, 7 yrs to max w/ periodic disturbances (avg ann output = 818)
Linear growth, 50 yrs to max (avg ann output = 461)
Year